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## First record of *Corbicula fluminea* (Mollusca: Bivalvia) in the Czech Republic

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**Abstract.** A non-native species of aquatic molluscs, bivalve *Corbicula fluminea* (O. F. Müller, 1774), was found in the Czech Republic in 1999. The species is native to eastern and south-eastern Asia. Altogether 8 specimens were found at 4 localities of the Elbe River in North Bohemia.

**Distribution, Mollusca, Bivalvia, *Corbicula fluminea*, Czech Republic**

### INTRODUCTION

The clam *Corbicula fluminea* (O. F. Müller, 1774) from the family Corbiculidae is native to eastern and south-eastern parts of Asia (Žadin 1952). The species was introduced by ships to the Europe from North America in about 1980 (Glöer & Meier-Brook 1994). In Europe it is recently recorded from the Iberian peninsula and France (Araújo et al. 1993), in Germany from the rivers Rhein, Neckar and Main (Glöer & Meier-Brook 1994). The nearest so far known locality is the Elbe River near Magdeburg (Grabow & Martens 1995).

### RESULTS

The first two specimens were identified by the author in the sample from the Elbe River in Hřensko (North Bohemia, Czech-German boundary, code of mapping square 5151<sup>1</sup>, September 3, 1999, leg. Stuchlík). Additional specimens were collected by the author on November 7, 1999 in the Elbe River at five localities between Czech-German boundary and Ústí nad Labem (Hřensko, code of mapping square 5151, 2 specimens; Dolní Žleb, 5151, 2 specimens; Děčín, 5151, part of one shell; Povrly, 5350, 1 specimen; coll. L. Beran; Ústí nad Labem, 5350, 1 specimen, all coll. L. Beran). Except for the locality Povrly, where living individual was detected in the main river stream (in sandy sediment, about 60 cm under water level), only shells or death individuals were found on river bank or in water in shallow places. The species seems to be very rare in all so far known localities. Mentioned part of the Elbe River is about 35 km long and absent of any weir or other barrier. Only finding from Ústí nad Labem originated from downstream of the Střekov Weir. Population of *Corbicula fluminea* in the Elbe River will be studied in the future.

<sup>1</sup> For details see Buchar (1982)

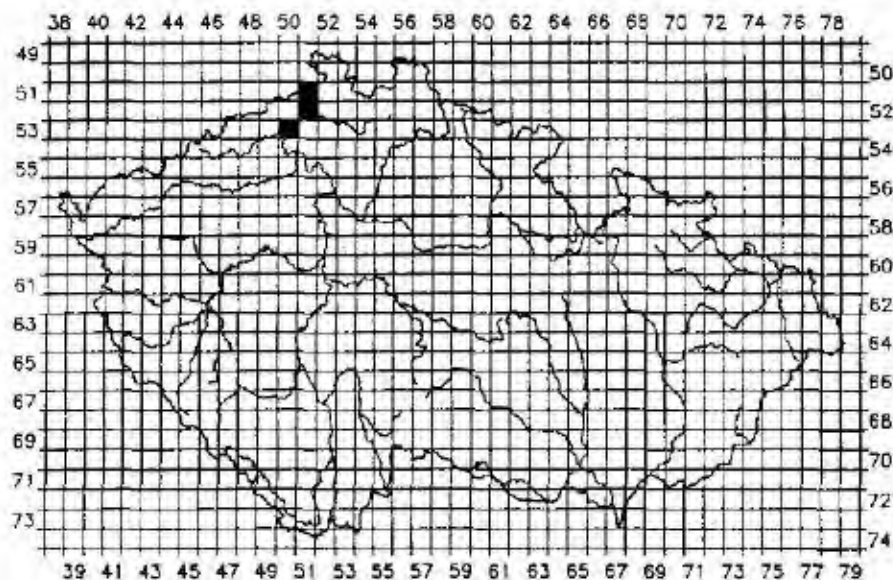


Fig. 1 Known distribution of *Corbicula fluminea* (O. F. Muller) in the Czech Republic

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## A revision of the genus *Microtrichalus* from Sumatra, with notes on Oriental and Australian species (Coleoptera: Lycidae)

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**Abstract.** The representatives of the genus *Microtrichalus* Pic, 1921 from Sumatra are revised. *Microtrichalus fuliginosus* (Bourgeois, 1883), *M. rouyeri* (Pic, 1921), and *M. testaceicollis* (Pic, 1927) are combined with *Microtrichalus* Pic, 1921 for the first time (all originally placed in *Trichalus* Waterhouse, 1877). *M. subicollis* sp. n. is described. *Trichalus laticornis* Pic, 1927, *T. javanus* Pic, 1927, *T. undulatiflorax* Pic, 1927, *T. nathus* Kleinc, 1933a, and *T. barbieri* Pic, 1949 are synonymized to *Microtrichalus communis* (Waterhouse, 1879). *Trichalus ranganus* Pic, 1921 to *Microtrichalus fuliginosus* (Bourgeois, 1883). *Trichalus diversus* Pic, 1927, *Trichalus inauditus* Kleinc, 1926a, and *Trichalus reductus* Pic, 1927 to *Microtrichalus rouyeri* (Pic, 1927). All species are redescribed and keyed. The following species occurring in adjacent regions are transferred to the genus *Microtrichalus* Pic, 1921: *Microtrichalus acutangulus* (Waterhouse, 1878), *M. amoenus* (Kleinc, 1929), *M. basipes* (Pic, 1923), *M. castigani* (Kleinc, 1931), *M. conditus* (Kleinc, 1926a), *M. detractus* (Waterhouse, 1879), *M. faustus* (Kleinc, 1935a), *M. favorabilis* (Kleinc, 1926b), *M. fraternulus* (Kleinc, 1925), *M. grandjeani* (Pic, 1930), *M. griseus* (Waterhouse, 1879), *M. ignotus* (Kleinc, 1936), *M. latesuturalis* (Pic, 1926), *M. lineolatus* (Kleinc, 1939), *M. minor* (Pic, 1923), *M. multicaulus* (Pic, 1921), *M. pallens* (Pic, 1921), *M. patricius* (Kleinc, 1935b), *M. pectoralis* (Pic, 1921), *M. perturbatus* (Waterhouse, 1879), *M. pubens* (Kleinc, 1935b), *M. pygmaeus* (Bourgeois, 1885), *M. residuus* (Kleinc, 1939), *M. sulcaliceps* (Pic, 1921), *M. tenimberensis* (Kleinc, 1933a), *M. testaceicollis* (Pic, 1921), all transferred from *Trichalus* Waterhouse, 1877, and *Microtrichalus atricolor* (Pic, 1921), *M. leyeri* (Kleinc, 1935b), and *M. pomeraniensis* (Pic, 1926), from *Leptotrichalus* Kleinc, 1925. *Trichalus bicoloripes* Pic, 1930 and *T. basicornis* Pic, 1930 are proposed to be junior synonyms of *Microtrichalus basipes* (Pic, 1923). Lectotypes for the following species are designated: *Trichalus bicoloripes* Pic, 1930, *T. barbieri* Pic, 1949, *T. faustus* Kleinc, 1935a, *T. favorabilis* Kleinc, 1926b, *T. laticornis* Pic, 1927, *T. ranganus* Pic, 1927, *T. rouyeri* Pic, 1921, *T. tenimberensis* Kleinc, 1933a, *T. testaceicollis* Pic, 1927, and *T. undulatiflorax* Pic, 1927.

**Taxonomy, new species, new combinations, new synonymies, key, distribution, Coleoptera, Lycidae, Metriorrhynchi, *Microtrichalus*, Oriental region**

### INTRODUCTION

Our knowledge of Oriental Lycidae is very often restricted to original short descriptions given by different authors before World War II and the described taxa have not been appropriately studied until now. The criteria used for generic classification were usually typological and it is necessary to revise classification of known species to genera. The generic classification of Metriorrhynchi with shortened first primary costa was revised by Bočák (1998a), who restricted the subtribe Trichalina to genera with a partly membranous apical part of the phallus and dorsally attached lateral accessory glands of the vagina, e.g., *Trichalus* Waterhouse, 1877, *Schizotrichalus* Kleinc, 1926, *Eniclaes* Waterhouse, 1879, *Microtrichalus* Pic, 1921 and *Flabellotrichalus* Pic, 1921.

The aim of this paper is a revision of restricted Trichalina from Sumatra. They have until now been classified in the genus *Trichalus* and I have found that they nearly all should be transferred to

*Microtrichalus* The first Oriental species were described in *Trichalus* at the end of last century (Waterhouse, 1879, Bourgeois, 1883), but more species were later added by Pic (1921, 1926, 1927, 1949) and Kleine (1926, 1933a). Both authors based their descriptions mostly on a single specimen or on a very limited series. Therefore, they often pointed out the shape of the pronotum or minute variation in the coloration in their descriptions. I have had the possibility to study more extensive material from many institutions and all types and I have found extensive synonymy in this group. Recent collecting activity in Sumatra yielded one new species from the montane rain forests of northern Sumatra and it is described here.

#### MATERIAL AND METHODS

All morphological measures were made using the ocular grid of an Olympus SZX-12 binocular microscope at the magnification 20 times for the body length and 90 times for remaining body parts. Eye diameter was measured in lateral view and when the eye outline was not circular the diameter was measured at the widest point. The interocular distance was taken from a dorsal view at the point of minimum eye distance. The ratios in descriptions are counted by division of measured points and therefore they can differ from those obtainable from data given in millimetres.

#### Depositories

- BMNH – Museum of Natural History, London, United Kingdom
- HNHM – Natural History Museum, Budapest, Hungary
- ISNB – Royal Belgian Institute of Natural Science Brussels, Belgium
- KMTC – Kiyochi Matsuda collection, Takarazuka city, Japan
- LMBC – Author's collection, deposited in the Collection of the Department of Zoology, Palacky University, Czech Republic
- MCSN – Museo civico di storia naturale "Giacomo Doria", Genova, Italy
- MNHN – Muséum National d'Histoire naturelle, Paris, France
- MNHIL – Nationaal Natuurhistorisch Museum, Leiden, the Netherlands
- SMNS – Staatliches Museum für Naturkunde, Stuttgart, Germany
- SKMC – Sergei Kasanisev collection, Moscow, Russia
- ZMAN – Zoologisch Museum, Universiteit van Amsterdam, the Netherlands
- ZMHB – Zoologisches Museum der Humboldt Universität, Berlin, Germany
- ZMPA – Museum and Institute of Zoology PAN, Warszawa, Poland

#### Genus *Microtrichalus* Pic, 1921

*Microtrichalus* Pic, 1921: 9, hors-texte (type species *M. singularis* Pic, 1921, by monotypy)

*Falsocnephia* Pic, 1926: 29, hors-texte, Bocák 1998a: 182 (type species *F. basipennis* Pic, 1926, by monotypy)

**DIAGNOSIS.** Pronotum with single median areola (Figs 9–12), elytra with four primary costae at humeri, primary costa 1 considerably shortened, secondary costae present in all interspaces between primary costae. Maxillary palpi slender. Apex of phallus narrow, apical part of internal sac free, with two slightly curved basal thorns. Membrane of phallobase never sclerotized or considerably pigmented (Figs 1–4). Vagina with dorsally inserted lateral glands and two lateral pockets (Figs 16–18).

**REDESCRIPTION.** Body small to medium sized, flattened dorso-ventrally. Head small, partly concealed by pronotum, antennae inserted in frontal part of cranium on antennal tubercles. Mouth parts directed downwards, inserted on small, short rostrum. Antennae with 11 antennomeres, considerably flattened. Antennomere 1 stout, antennomere 2 very small, partly hidden in apical part of antennomere 1, wider than long, antennomeres 3–10 serrate, more acutely in male, antennomere 11 elliptic. Pronotum flat, rounded in frontal part, with more or less projected posterior angles and lenti-like median areola. Lateral margins usually elevated. Scutellum flat, apical margin regularly emarginate. Elytra flat, parallel-sided to more or less widened backward, with strengthened lateral



and sutural margin. Four strong longitudinal costae present in basal part of elytra, costa 1 reaching at most one sixth of elytral length, costae 2 to 4 reaching at least five sixth of elytral length. Secondary costae developed in all interspaces, generally much weaker than primary ones, sometimes irregularly interrupted. Secondary and primary costae connected by small transverse costae. Abdomen flat, with eight visible segments in male and seven segments in female. Male genitalia consist of phallus and phallobase only, paramerae absent. Phallus slim, internal sac visible, partially pigmented, with two basal thorns at base, sometimes two apically connected rods observable in apical part of internal sac. Phallobase ring-like, with hole covered with membrane (Figs 1–4). Female genitalia with well separated styli, coxites and valvifers, valvifers sometimes fused at base (Figs 13–15). Vagina slim, with two lateral pockets and dorsally inserted lateral glands. Spermathecal duct moderately long, slightly curved, spermatheca well marked, lemon-like, spermathecal gland y-shaped (Figs 16–18). Legs moderately strong to slim, always considerably flattened.

**DISTRIBUTION.** *Microtrichalus* is widely distributed in the eastern part of the Oriental Region (Thailand, Laos, Vietnam, Malaysia, Great Sunda, the Philippines) and in the tropical part of Australian Region (Moluccas, Lesser Sunda, New Guinea and Solomon islands). Some Australian species are known from northern Queensland. The exact extent of the range of *Microtrichalus* in Australia is at present unknown.

### *Microtrichalus communis* (Waterhouse, 1879)

(Figs 4, 6)

*Trichalus communis* Waterhouse, 1879: 71

*Microtrichalus communis* Bocák, 1998: 426

*Trichalus laticornis* Pic, 1927: 42, hors texte; *syn. n.*

*Trichalus undulatus* Pic, 1927: 42, hors texte; *syn. n.*

*Trichalus javanus* Pic, 1927: 42, hors texte; *syn. n.*

*Trichalus nothus* Kleine, 1933a: 12, *syn. n.*

*Trichalus barhieri* Pic, 1949: 14; *syn. n.*

**TYPE MATERIAL EXAMINED.** Holotype of *Trichalus communis*, male – “Java” (BMNH). Lectotype of *T. laticornis* (hereby designated), male, “Sumatra, Brastagi, 1300 m, 14–5–1921, J. B. Corporaal” (MHNP). Paralectotype: 1 female, same data (MHNP). Lectotype of *T. barhieri* (hereby designated): 1 male, “Vietnam, Champ-My-An, Barhieri” (MHNP); paralectotypes, 2 males, 2 females, same locality data (MHNP). Lectotype of *T. undulatus* (hereby designated), (Indonesia) “Siag Pahang, 8–12–1919, Corporaal” (MHNP). Holotype of *T. javanus* female, “Java occident., Sukabumi, 2000’, 1893, H. Fruhstorfer” (MHNP). Allotype of *T. nothus* female, “Sumatra, Sibolga, No. 43, 16 x 1925, Fulmek & Karny” (ZMPA, the holotype should be deposited in the Bogor Museum, Indonesia, and has not been studied).

**ADDITIONAL MATERIAL EXAMINED.** **Indonesia:** 1 male, N. Sumatra, Brastagi, May 1991, J. Moravec lgt. (LMBC); 1 male, N. Sumatra, Hutapadang, 400 m, 20 km SE Siantar, 10–8–1991, Erber lgt. (LMBC); 1 male, W. Sumatra, Merapi, 1992, native collector (LMBC); 1 male, Sumatra, Bengkulu, 20 km sudl. Muko Muko, 16–8–1991, lgt. Erber (LMBC); 2 males, 2 females, Aceh, 20 km N of Ronga Ronga, 26 Feb 1998, 800 m, L. Bocák lgt. (LMBC); 3 males, Sumatra, Fort de Cock, 920 m, Dec. 1920, Mai 1921, Juni 1921, lgt. H. Jacobson (MIZW); 1 female, Sumatra, Padang, 1890, E. Modigliani (MIZW); 1 female, Sumatra, Sibolga, x 1890, E. Modigliani (MIZW); 52 males, 47 females, Java centr., Lasem env., 4 km E Gunung Celering, 13–24. I. 1998, R. Červenka lgt. (LMBC). **Malaysia:** 1 male, Johore, Kota Tinggi, August 1917 (MIZW).

**DIFFERENTIAL DIAGNOSIS.** *M. communis* differs from the all Oriental *Microtrichalus* species in the coloration of the pronotum and elytra. Additionally, *M. communis* has slender, nearly parallel-sided male genitalia (Fig. 4), and small eyes.

**REDESCRIPTION.** Male – Body medium sized, flat, slightly widened backward, piceous brown to black. Pro- and mesothorax lighter brown, pronotum, scutellum and elytra except apical half to fifth yellow. Head small, partly hidden by pronotum, covered with sparse pubescence, antennal tubercles distinct, clypeus widely and quite deeply emarginate. Labrum occupying seven tenths of width

of clypeal frontal margin. Mandibles short, stout, maxilla with long lacinia, maxillary palpi slender, labial palpi short, apical palpomere acutely pointed. Antennae reach slightly over elytral midlength, serrate, strongly compressed (Fig. 6). Interocular distance 1.27 times longer than maximum eye diameter. Pronotum 1.45–1.50 times wider than long, flat, trapezoidal, widest at basal margin, median areola attached directly to both frontal and basal margins, weak lateral tubercle at basal third. Scutellum flat, approximately as wide as long, widely emarginate at apex. Elytra widest at apical fifth, with three costae developed in whole length, costa 1 occupy basal fifth of elytral length. Costae 2 and 3 join each other before apex. All primary costae of equal strength, much stouter than secondary ones. Legs very strongly compressed, moderately long. Male genitalia with well developed thorns, phallus tube-like, internal sac retracted into phallus, unpigmented (Fig. 4).

Female - Genitalia with slender vagina. Ovipositor very slender, with long valvifers and styli.

MEASURES. Length 6.3–7.8 mm, width at humeri 1.40–2.07 mm, length of pronotum 0.94–1.15 mm, width of pronotum 1.37–1.72 mm, distance of eyes in male 0.62 mm, maximum diameter of eyes in male 0.49 mm.

DISTRIBUTION. Malaysia, Vietnam, Sumatra, Java, Borneo, Palawan, Lesser Sundas.

REMARK. Unlike other lycids, *M. communis* occurs in dry secondary grass and shrub habitats.

### *Microtrichalus fuliginosus* (Bourgeois 1883) comb. n.

(Figs 2, 8, 12)

*Trichalus fuliginosus* Bourgeois, 1883: 646.

*Trichalus ranganus* Pic, 1927: 41; syn. n.

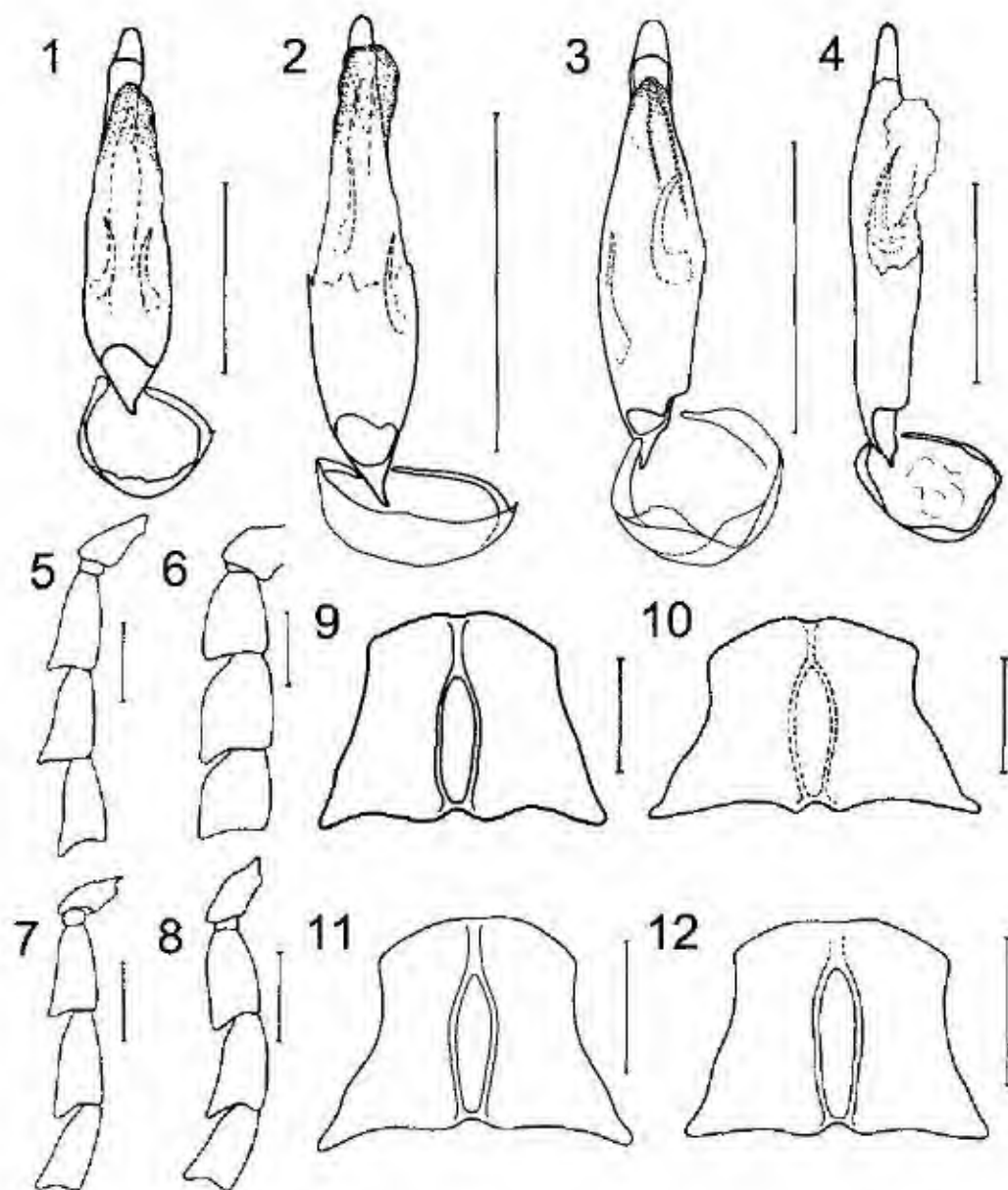
TYPE MATERIAL EXAMINED. Holotype, female, "Borneo, Sarawak, 1865–66, Coll. G. Dorn" (MCSN). Lectotype of *T. ranganus* (hereby designated), female – "Indonesia, Mana Riang, Ranau Palembang, April 20, 2–5000", I. Z. Kannegieter" (MHNP). Paralectotypes: 2 females, same locality data (MHNP).

ADDITIONAL MATERIAL EXAMINED. China: 1 male, Yunnan, Pu'er 19. vii 1990 (LMBC). Indonesia: 1 male, Sumatra (North), 8 km S of Prapat, 8–13 Mar 1998, L. Bocák lgt., 1 female, NE Sumatra, Deli, Negerilama, viii 1954, A. Soliaart, Lowland forest (MNHL), 1 male, 3 females, W Sumatra, Bukitunggut, 6 vii 1995, S. Jakl lgt. (LMBC), 4 males, 2 females, Sumatra, Lau Rakit, Corporaal, 300 m (ZMAN), 2 males, 3 females, Sumatra, Sibolangit, Corporaal (ZMAN); 1 male, 1 female, Sumatra, Osthaven, Maart, 1950, C. v. Nidek (ZMAN); 1 male, Sumatra, Prasa Oeloe, 12. 2. 1920, Corporaal (ZMAN); 2 males, Sumatra, Boschres Bandar, Corporaal 15. vii 1920 (ZMAN); 1 male, Sumatra, Pagar Marbau, 44 m, Corporaal (ZMAN); 6 males, 2 females, Depok, Juni – Dec 1949, C. v. Nidek (ZMAN, LMBC); 1 male, Java, S. Tjerimai, ii 1906, Drescher (ZMPA), 1 male, Java, G. Tangkoeban Prahoe, 4000–5000 Voet, Preanger, xii 1934 (ZMPA), Laos, 1 male, Sekong Prov., N slope of Bolovens Plateau, ca 10 km N Muang Tha Teng, 30. v. 1996, Leg. C. Holzschuh (LMBC), 1 male, Louangnamtha Prov., Namtha to Muang Sing, 5–31 v. 1997, 900–1200 m, V. Kubán lgt. (LMBC), Malaysia, 1 male, Perak, Banjaran Bintang, Bukit Berapit, Taiping, 11–12. 3. 1997, J. Jenis lgt. (LMBC), 1 female, Perak, Doherty (ZMPA), Thailand, 1 male, Betong, 23–25. 5. 1992, J. Horák (LMBC); 1 male, Betong, Gunung Cang dun vill Yala distr., 25. 3.–22. 4. 1993, J. Horák lgt. (LMBC); 1 female, Trang, native coll. ii. 1989 (LMBC); 1 male, Sarawak, Kapit distr., Rumah Ugap vill Sut riv., 3–9. 3. 1994, J. Horák lgt. (LMBC), 4 males, 3 females, Sarawak, foot Mt Dulit, Tinjar riv. 12. vii.–23. x. 1932 Oxford Univ. Exp. (BMNH), Vietnam, 1 male, Nam Ma, nr Dong Pao, 31. 5. 1963, Kabakov (SKMC).

DIFFERENTIAL DIAGNOSIS. *M. fuliginosus* is externally indistinguishable from the closely related Sumatran species *M. rouyeri* with the dark brown body. These species differ in the size of eyes, *M. fuliginosus* having them considerably smaller in both sexes. Both male and female genitalia are very similar and do not help in identification (Fig. 2).

REDESCRIPTION. Male – Body small, moderately slender, dark brown, only very narrow basal part of humeri and short part of elytral costae lighter brown. Head small, including eyes slightly wider than anterior margin of pronotum. Eyes hemispherically prominent, interocular distance  $0.89 \pm 0.04$  times shorter than maximum eye diameter. Antennae reaching slightly over elytral midlength, acutely serrate, antennomeres 3–10 compressed (Fig. 8). Antennal tubercles flat, followed by shallow de-





Figs 1-12. 1-4: Male genitalia: 1 - *Microtrichalus testaceicollis* Pic, 2 - *M. fuliginosus* Bourgeois, 3 - *M. rubricollis* sp. n., 4 - *M. communis* Waterhouse, Figs 5-8: Male basal antennomeres: 5 - *M. testaceicollis* Pic, 6 - *M. communis* Waterhouse, 8 - *M. rubricollis* sp. n., 8 - *M. fuliginosus* Bourgeois, Figs 9-11: Pronotum: 9 - *M. testaceicollis* Pic, 10 - *M. rouyeri* Pic, 11 - *M. rubricollis* sp. n., 12 - *M. fuliginosus* Bourgeois. Scales 0.5 mm.

pression behind them. Clypeus widely concave, labrum bilobe at apex, palpi slender, apical palpomeres pointed. Pronotum 1.46 times wider than long, narrowest at frontal margin, gradually widening to base, posterior angles acutely projected, punctured at margins, disc shining, covered by long sparse pubescence. Scutellum emarginate at apex, as long as wide. Elytra parallel-sided to slightly widened backward, flat, primary costa 1 short, reaching slightly over one sixth of elytral length. Secondary costae well developed, only seldom interrupted, transverse costae irregular, similarly stout as secondary ones. Legs moderately slender, compressed. Phallus slender (Fig. 2).

Female – Body larger, interocular distance  $0.75 \pm 0.03$  times shorter than maximum eye diameter. Ovipositor with very thin bridge between valvifers and connecting projections at bases of coxites. Vagina moderately slender, with sclerotized basal part of glandular ducts.

MEASURES. Male – Length of body 5.65–7.5 mm, width at humeri 1.34–1.65 mm, length of pronotum 0.76–0.95 mm, width of pronotum 1.11–1.55 mm, female (holotype of *M. fuliginosus*): interocular distance 0.54 mm, maximum diameter of eyes 0.40 mm.

VARIABILITY. The lighter part at bases of elytra is distinct in some specimens only.

DISTRIBUTION. Widespread species known from Sumatra, Borneo, Peninsular Malaysia, Thailand, Laos, Vietnam, and Yunnan. *Microtrichalus fuliginosus* is the only representative of Trichalina known from China and it is reported here from this country for the first time.

### *Microtrichalus rouyeri* (Pic, 1921) comb. n.

(Figs 10, 13, 16)

*Trichalus rouyeri* Pic, 1921: 11, hors-texte.

*Trichalus diversus* Pic, 1927: 41, hors-texte, syn. n.

*Trichalus inconstans* Kleinc, 1926a: 312, syn. n.

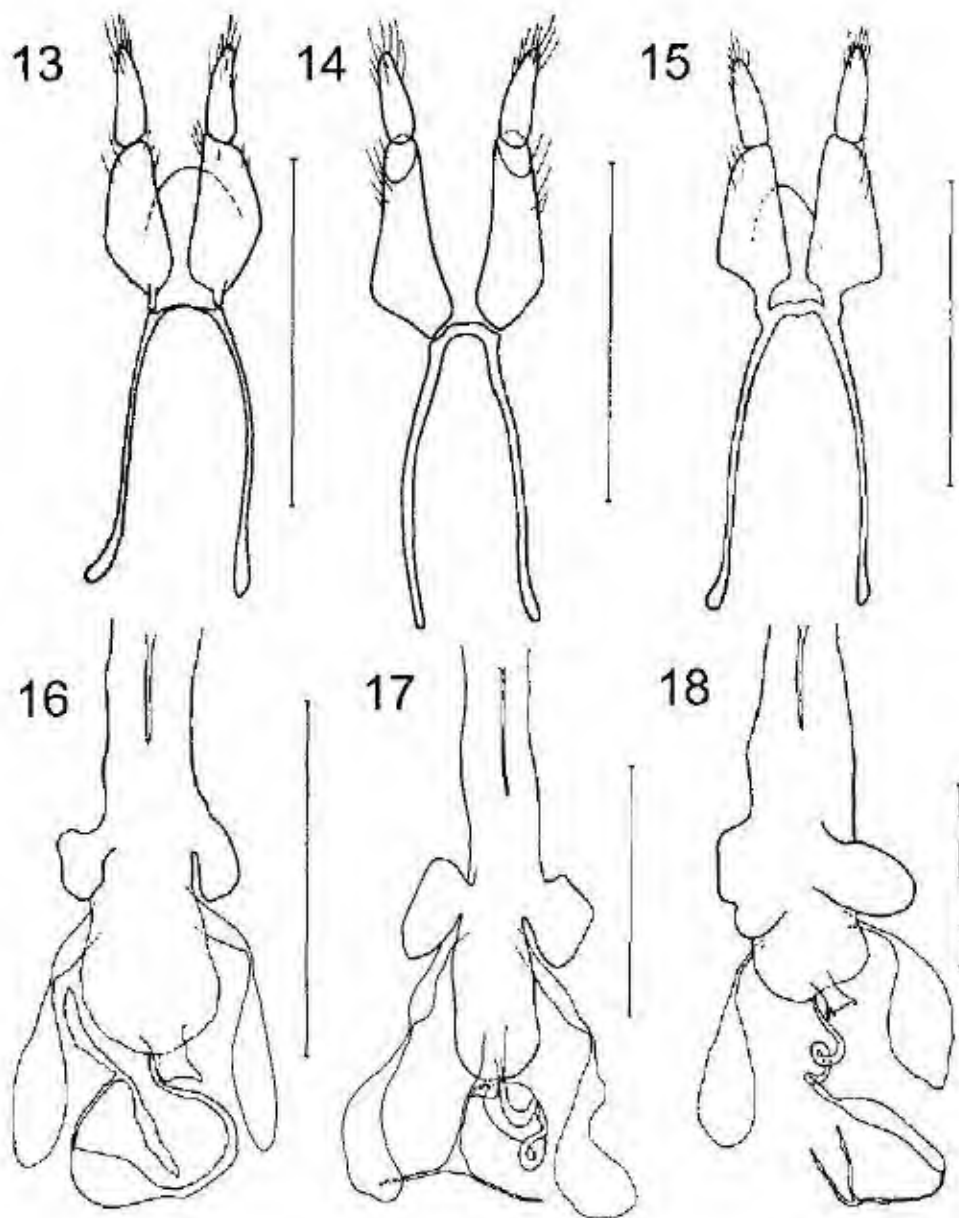
*Trichalus reductus* Pic, 1927: 42, hors-texte, syn. n.

TYPE MATERIAL EXAMINED. Lectotype of *T. rouyeri* (hereby designated), male – Indonesia, "Sumatra's O. K., Medan, 20 m. 9. 2. 1920, J. B. Corporaal" (MHNP), paralectotypes: 1 female, dito (MHNP), 1 female, "Mana Riang, Palembang" (MHNP), 1 male, Medan, Mjoeberg (MHNP). Holotype of *T. inconstans*, male – "Quap, W. Sarawak, G. B. Bryant, vi. 1914" (SMNH). ?Type of *T. reductus*, female – Indonesia, Java, Preanger. Cg. Secsoeroeb, J. B. Corporaal (MHNP). Holotype of *T. diversus*, male, "Kina Balu" (MHNP).

ADDITIONAL MATERIAL EXAMINED. Indonesia: 1 male, 5 females, Sumatra, Marina, M. Knappert (MNHL); 1 male, 1 female, Sumatra, Medan, Corporaal, xii. 1920, 19. i. 1921 (ZMAN, ZMPA); 1 female, Sumatra, Sibolangit, J. A. Loerzing, 17. x. 1921 (ZMPA); 1 female, Sumatra, Bukittinggi, 6. vi. 1966, S. Jaki (LMBC); Malaysia: 1 female, Sarawak, Kapit Dist., Sebong, Bateh riv., 9.–21. iii. 1994, J. Horák lgt (LMBC). Vietnam: 2 males, 1 female, Buon-lei, 40 km N of Ankhio, Prov. Gra-lai Kontum, 12. 6.–2. vii. 1983 (SMNS), 1 female, Prov. Ze-lai Kontum, 8 km N Kon Hamut, 26. vi. 1983 (SKMC).

DIFFERENTIAL DIAGNOSIS. *M. rouyeri* is externally very similar to *M. fuliginosus*. These species differ in the size of eyes in both sexes.

DESCRIPTION. Male – Body small, moderately slender, dark brown, seldom very narrow basal part of humeri lighter brown. Head small, eyes large, hemispherically prominent,  $1.20 \pm 0.10$  times larger than their minimum frontal interocular distance. Antennae reaching slightly over elytral midlength, acutely serrate, antennomeres 3–10 compressed. Antennal tubercles flat, followed by shallow depression behind them. Clypeus widely concave, labrum bilobe at apex, palpi very slender, apical palpomeres pointed. Pronotum 1.4–1.55 times wider than long, narrowest at frontal margin, gradually widening to base, posterior angles more or less acutely projected, punctured at margins, disc shining. Scutellum emarginate at apex, as long as wide. Elytra parallel-sided to slightly widened backward, flat, primary costa 1 short, reaching slightly over one sixth of elytral length. Secondary costae well developed, only seldom interrupted, transverse costae irregular, similarly stout as secondary ones. Legs moderately slender, compressed. Phallus slender identical with *T. fuliginosus*.



Figs 13-18. 13-15: Ovipositor: 13 - *Microtrichalus rouyeri* Pic, 14 - *M. rubricollis* sp. n., 15 - *M. testaceicollis* Pic, Figs 16-18: Female genitalia: 16 - *M. rouyeri* Pic, 17 - *M. rubricollis* sp. n., 18 - *M. testaceicollis* Pic. Scales 0.5 mm.

Female – Body slightly larger, eyes  $0.84 \pm 0.03$  times smaller than their minimum interocular distance

MEASURES Male – Length of body 5.5–7.0 mm, width at humeri 1.55–1.75 mm, holotype of *M. rouyeri* interocular distance 0.52 mm, maximum diameter of eyes 0.42 mm

DISTRIBUTION Java, Sumatra, Borneo, Vietnam

REMARK Kleine (1933b) stated that *M. reductus* was described from Sumatra by Pic (1927), but in the Pic's article this name is given in the way admitting the possibility that it was described sooner. Therefore, I have tried to found any older description, but I was unsuccessful despite longer searching. I have found only one specimen from Java in the Paris Museum with locality data given above with a hand written Pic's label "*Trichalus reductus* n. sp." Pic designated all types only in this way and it is possible that this specimen is the holotype. It is possible, that Sumatra was given by Pic (1927) by mistake, because no specimen from Sumatra was found in Pic's collection and the Corporaal's locality label reminds those used for numerous Sumatran materials.

***Microtrichalus rubricollis* sp. n.**

(Figs 3, 7, 11, 14, 17)

TYPE MATERIAL EXAMINED Holotype, male – Indonesia, Sumatra (Aceh) 20 km S of Blangkejeren, Kodah, 4–8 Mar 1998, 1700 m, L. Becak lgt (LMBC); Paratypes 5 females, same locality data (LMBC)

DIFFERENTIAL DIAGNOSIS *Microtrichalus rubricollis* sp. n. is well characterized by its colour pattern. It is the only Asian species with black elytra and the orange yellow pronotum.

DESCRIPTION Male – Body medium-sized, slender, nearly parallel-sided, black, pronotum bright orange yellow, scutellum, trochanters and prosternum brown. Head small, including eyes only slightly wider than anterior margin of pronotum, frons depressed in middle, antennal tubercles prominent. Eyes large, hemispherically prominent, interocular distance 1.11 times longer than maximum eye diameter. Anterior margin of clypeus widely concave, labrum emarginate at apex, both palpi slender, apical palpomeres pointed at apex. Antennae surpass three fifths of elytral length, serrate, antennomeres 3–11 strongly compressed, antennomere 2 very short, antennomere 3 longest (Fig. 7), following antennomeres gradually shortening. Pronotum 1.55 times wider than long, flat, parallel-sided in anterior portion, with acutely projected hind angles (Fig. 11). Scutellum as long as width, emarginate at apex. Elytra flat, slightly divergent in apical third, primary costa 1 occupying less than one fifth of elytral length, primary costa 3 shorter than costae 2 and 4, secondary costae very weak, often interrupted. Legs slender, strongly compressed. Male genitalia slender, widest in middle, phallobase ring-shaped, subtle (Fig. 3).

Female – Body only slightly broader, antennae shorter and broader. Ovipositor (Fig. 14) with fused bases of valvifers. Vagina very slender, ducts of lateral accessory glands robust, partly sclerotized, lateral pockets large (Fig. 17).

MEASURES Male (holotype) – Length of body 6.6 mm, width at humeri 5.05 mm, length of pronotum 0.84 mm, width of pronotum 1.30 mm, interocular distance 0.38 mm, maximum diameter of eyes 0.42 mm.

NAME DERIVATION Named according to the coloration of the pronotum.

VARIABILITY The extent of pale portions of the scutellum and trochanters is a subject of variability.

DISTRIBUTION Sumatra, known from the type locality only.

BIONOMY *Microtrichalus rubricollis* was collected by sweeping of the lowest herbaceous stratum and bushes in mountainous *Lithocarpus-Castanopsis* forest.

***Microtrichalus testaceicollis* (Pic, 1927) comb. n.**  
(Figs 1, 5, 9, 15, 18)

*Trichalus testaceicollis* Pic, 1927: 42, hors-texte

TYPE MATERIAL EXAMINED. Lectotype (hereby designated), male - (Indonesia), "Sumatra's O. K., Brastagi, 1300 m, 14.2.1921, J. B. Corporaal" (MHNP). Paralectotype: 1 male, "Sumatra, Mjoeberg" (MHNP).  
ADDITIONAL MATERIAL EXAMINED. **Indonesia.** 5 males, 6 females, Sumatra (N.) Brastagi, G. Sibayak, 1450-1900 m, 19-23.ii.1991, Bocák and Bocáková lgt. (LMBC); 1 male, N. Sumatra, Brastagi, G. Sibayak, viii.1992 (LMBC); 2 females, Sumatra (N.), 30 km SW of Brastagi, G. Sinnabung, 1300-1800 m, 22.ii.1991, L. Bocák and M. Bocáková lgt. (LMBC); 1 male, 1 female, Sumatra (North), Brastagi, G. Sinnabung, 1500-2000 m, 14-17. Mar. 1998, L. Bocák lgt. (LMBC). 1 female, N. Sumatra, Mt. Dairi, 27.iii.1984, leg. G. Hangay (MHNB). 1 male, Sumatra, Sinabong, Dohrn (ZMPA).

**DIFFERENTIAL DIAGNOSIS.** *M. testaceicollis* reminds *M. rubricollis* by the light coloured pronotum and the slender body, but it differs in the considerably lighter brown elytra and slightly bigger male eyes.

**DESCRIPTION:** Male - Body medium-sized, slender, dark brown, pronotum yellow. Trochanters, mesosternum and sometimes scutellum slightly lighter than sternum of metathorax. Elytra lighter than body, grayish brown, humeral part sometimes slightly lighter than rest of elytra. Head small, including eyes slightly wider than anterior margin of pronotum, eyes hemispherically prominent, interocular distance 1.03 times longer than maximum eye diameter, antennal tubercles distinct, with deep depression behind them. Clypeus slightly emarginate at apex, palpi moderately slender, terminal palpomere pointed at apex. Antennae surpassing half of elytral length, antennomeres 3-11 compressed, serrate, shortening to apex (Fig. 5). Pronotum flat, 1.50 times wider than long, widest at base, with acutely projected hind angles. Scutellum depressed in middle, widely emarginate at apex. Elytra parallel-sided, with three primary costae in middle, primary costa 1 reaching one sixth of elytral length. Legs slender, compressed. Phallus slender, with subtle ring-formed phallobase (Fig. 1).

Female - Slightly more robust. Ovipositor with fused basal parts of valvifers, connected firmly to coxites (Fig. 15). Vagina moderately slender, spermatheca slender (Fig. 18).

**MEASURES.** Male - Length of body 6.55-8.45 mm, width at humeri 1.51-1.76 mm, length of pronotum 0.83-0.92 mm, width of pronotum 1.22-1.35 mm, interocular distance 0.43 mm, maximum diameter of eyes 0.45 mm.

**VARIABILITY.** Slightly lighter coloration of elytra as well as lighter scutellum were found in several specimens.

**DISTRIBUTION.** Sumatra, known from the vicinity of Brastagi and Mt. Dairi in Northern Sumatra.

**BIONOMY.** *M. testaceicollis* is a quite common species in mountainous *Lithocarpus-Castanopsis* forests, where it was swept on the low stratum of canopy by the author.

**Key to Sumatran species of *Microtrichalus***

1. Whole body dark brown to black, at most humeral part of elytra slightly lighter ..... 4
- At least pronotum light yellow to orange yellow. .... 2
2. Pronotum and elytra yellow except apical fifth to half of later, phallus parallel-sided (Fig. 4), interocular distance in male 1.27 times longer than maximum eye diameter. .... *M. communis* (Waterhouse)
- Whole elytra concolorous, slenderer species. .... 3
3. Elytra light brown, interocular distance in male about as long as eye maximum diameter ..... *M. testaceicollis* (Pic)
- Elytra dark brown to black, interocular distance in male 1.1 longer than eye maximum diameter ..... *M. rubricollis* sp. n.

4. Eyes  $1.20 \pm 0.10$  times larger than their distance in male,  $0.84 \pm 0.03$  times smaller than their minimum interocular distance in females *M. rouyeri* (Pic)  
 - Eyes  $0.89 \pm 0.04$  times smaller than their distance in male,  $0.75 \pm 0.03$  times smaller than their minimum interocular distance in females *M. fuliginosus* (Bourgeois)

#### **List of additional species newly combined with the genus *Microtrichalus* Pic, 1921**

During the study of Australian and Oriental species of Trichalina I have found that many species now classified in *Trichalus* should be transferred to *Microtrichalus*. The complete revision of the fauna of many regions is difficult because of inaccessibility of a part of types and the general lack of a more extensive material from many regions. Therefore I propose here only new combinations with the genus *Microtrichalus*, which are based on the study of primary types in visited institutions as given in depositories.

#### ***Microtrichalus acutangulus* (Waterhouse, 1878) comb. n.**

*Trichalus acutangulus* Waterhouse, 1878: 114

TYPE MATERIAL EXAMINED: Holotype, male, "59 58, Dory, New Guinea" (BMNH)

#### ***Microtrichalus atricolor* (Pic, 1921) comb. n.**

*Leptotrachelus atricolor* Pic, 1921: 41, hors-texte

TYPE MATERIAL EXAMINED: Holotype, male, "G. Tj. Salimar, W. Preanger, 3000', Sept. 95, I. Z. Kannegeter" (MHNP)

#### ***Microtrichalus amoenus* (Kleine, 1929) comb. n.**

*Trichalus amoenus* Kleine, 1929: 477

TYPE MATERIAL EXAMINED: Holotype, male, "Kuranda, N. Queensland, G. E. Bryant, Feb. 1909" (BMNH)

#### ***Microtrichalus basipes* (Pic, 1923) comb. n.**

*Trichalus basipes* Pic, 1923: 36, hors-texte

*Trichalus bicoloripes* Pic, 1930: 92, hors-texte, syn. n.

*Trichalus basicornis* Pic, 1930: 92, hors-texte, syn. n.

TYPE MATERIAL EXAMINED: Holotype of *M. basipes*, male, "Humboldt Bay, N. G., Doherty lgt" (MHNP); lectotype of *T. bicoloripes* (hereby designated), male, "Stephansort, Astrolabe Bay, Nlle Guinee" paralecotype, male, same data (MHNP); holotype of *T. basicornis*, male, "N. Guinee" (MHNP)

#### ***Microtrichalus castigatus* (Kleine, 1931) comb. n.**

*Trichalus castigatus* Kleine, 1931: 287

TYPE MATERIAL EXAMINED: Holotype, female, "F. C. Drescher, G. Tangkocban Prahoc, 4000 - 5000 Voet, Preanger, Java, 14. V. 1930" (ZMPA)

#### ***Microtrichalus conditus* (Kleine, 1926) comb. n.**

*Trichalus conditus* Kleine, 1926: 312

TYPE MATERIAL EXAMINED: Syntype, male, "G. Papamdajan, Java, 3/1915, Drescher" (MZPA)



***Microtrichalus detractus* (Waterhouse, 1879) comb. n.**

*Trichalus detractus* Waterhouse, 1879: 70

TYPE MATERIAL EXAMINED: Holotype, male, "Waigiu", New Guinea" (BMNH)

***Microtrichalus faustus* (Kleine, 1935a) comb. n.**

*Trichalus faustus* Kleine, 1935a: 317

TYPE MATERIAL EXAMINED: Lectotype (hereby designated), male, "Papua, Kokoda, 1200 ft, iv 1933, L. E. Cheesman" (BMNH)

***Microtrichalus favorabilis* (Kleine, 1926b) comb. n.**

*Trichalus favorabilis* Kleine, 1926b: 177

TYPE MATERIAL EXAMINED: Lectotype (hereby designated), female, "Nou Britannica, Ralun, E. Dahl S." (ZMHB)

***Microtrichalus fraterculus* (Kleine, 1925) comb. n.**

*Trichalus fraterculus* Kleine, 1925: 36

TYPE MATERIAL EXAMINED: Holotype, male, "L. J. Toxopeus, Buru, Station 13, ult. Aug. 1921" (ZMAN)

***Microtrichalus grandjeani* (Pic, 1930) comb. n.**

*Trichalus grandjeani* Pic, 1930: 92, hors-texte

TYPE MATERIAL EXAMINED: Holotype, female, "Nouvelle Guinee" (MHNP)

***Microtrichalus griseus* (Waterhouse, 1879) comb. n.**

*Trichalus griseus* Waterhouse, 1879: 69

TYPE MATERIAL EXAMINED: Holotype, male, "New Guinea, Dory, 59-58" (BMNH)

***Microtrichalus ignotus* (Kleine, 1936) comb. n.**

*Trichalus ignotus* Kleine, 1936: 133

TYPE MATERIAL EXAMINED: Syntypes, 2 females, "F. C. Drescher, G. Tangkoeban Prahoc, 4000 - 5000 Voet, Preanger, Java, 3-5 ii 1933, 9 iii - 12 iv 1933" (ZMPA)

***Microtrichalus latesuturalis* (Pic, 1926) comb. n.**

*Trichalus latesuturalis* Pic, 1926: 30, hors-texte

TYPE MATERIAL EXAMINED: Holotype, male, "Stephansort", New Guinea (MHNP)

***Microtrichalus leveri* (Kleine, 1935b) comb. n.**

*Leptotrachalus leveri* Kleine, 1935b: 181

TYPE MATERIAL EXAMINED: Holotype, female, "Solomon Is., Guadalcanal, Popanu, R. A. Lever, 15 xii 1934" (BMNH)

***Microtrichalus lineolatus* (Kleine, 1939) comb. n.**

*Trichalus lineolatus* Kleine, 1939: 132

TYPE MATERIAL EXAMINED. Holotype, male, "Mt. Lawoc, Java, Sarangan, 1400 m, vi 1934, D. P. Erdbrink" (MZPA).

***Microtrichalus milnei* (Pic, 1923) comb. n.**

*Trichalus milnei* Pic, 1923: 36, hors-texte.

TYPE MATERIAL EXAMINED. Holotype, female, "N. Guinée" (MHNP).

***Microtrichalus multicostatus* (Pic, 1921) comb. n.**

*Trichalus multicostatus* Pic, 1921: 10, hors-texte.

TYPE MATERIAL EXAMINED. Holotype, male, "Ins. Kei" (MHNP).

***Microtrichalus pallescens* (Pic, 1921) comb. n.**

*Trichalus pallescens* Pic, 1921: 10, hors-texte.

TYPE MATERIAL EXAMINED. Holotype, male "S. Celebes, Bua-Kraeng, 5000', Febr. 1896, H. Fruhstorfer" (MHNP).

***Microtrichalus patricius* (Kleine, 1935b) comb. n.**

*Trichalus patricius* Kleine, 1935b: 178.

TYPE MATERIAL EXAMINED. Holotype, male, "New Britain, Rabaul, I viii 1934, J. L. Froggatt leg." (BMNH).

***Microtrichalus pectoralis* (Pic, 1921) comb. n.**

*Trichalus pectoralis* Pic, 1921: 10, hors-texte.

TYPE MATERIAL EXAMINED. Holotype, female, "Stephansort, Astrolabe bay, D. N. Guinea, Kunzmann 1894" (MHNP).

***Microtrichalus perturbatus* (Waterhouse, 1879) comb. n.**

*Trichalus perturbatus* Waterhouse, 1879: 70.

TYPE MATERIAL EXAMINED. Holotype, male, "59 58, Dory, New Guinea" (BMNH).

***Microtrichalus pomeraniensis* (Pic, 1926) comb. n.**

*Leptotrachelus pomeraniensis* Pic, 1926: 30, hors-texte.

TYPE MATERIAL EXAMINED. Holotype, female, "Neu-Pommern" (MHNP).

***Microtrichalus pubens* (Kleine, 1935b) comb. n.**

*Trichalus pubens* Kleine, 1935b: 179.

TYPE MATERIAL EXAMINED. Holotype, female, "Solomon Is., San Cristobal, Kirakira, 4. 5 1934, R. A. Lever" (BMNH).

***Microtrichalus pygoxanthus* (Bourgeois, 1885) comb. n.**

*Trichalus pygoxanthus* Bourgeois, 1885: 84.

TYPE MATERIAL EXAMINED Holotype, female, "Moluques, coll. Ogier de Baulmy, M. R. Belg." (MCSN)

***Microtrichalus residuus* (Kleine, 1939) comb. n.**

*Trichalus residuus* Kleine, 1939: 590

TYPE MATERIAL EXAMINED Holotype, male, "Solomon Is., Tulagi, R. A. Lever" (BMNH), paralectotypes: 1 male, "Solomon Is.", "Guadalcanal, Popanu, R. A. Lever" (BMNH), 1 female, "Solomon Is., Guadalcanal, Benu, 1200 ft., xi, 1934, R. A. Lever" (BMNH)

***Microtrichalus sulcaticeps* (Pic, 1921) comb. n.**

*Trichalus sulcaticeps* Pic, 1921: 10

TYPE MATERIAL EXAMINED Lectotype (hereby designated), female, "Java orient., Montes Tengger, 4000', 1890, H. Fruhstorfer" (MHNP), paralectotype, female, same locality data (MHNP)

***Microtrichalus tenimberensis* (Kleine, 1933a) comb. n.**

*Trichalus tenimberensis* Kleine, 1933a: 11

TYPE MATERIAL EXAMINED Lectotype (hereby designated), male, "Jendema, Tenimber, Doherty vi - vii" (BMNH)

***Microtrichalus testaceicoxis* (Pic, 1921) comb. n.**

*Trichalus testaceicoxis* Pic, 1921: 10 hors-texte

TYPE MATERIAL EXAMINED Holotype, female, "Java" (MHNP)

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## Amphibians and reptiles recently recorded in Libya

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**Abstract.** The presented paper summarizes herpetological faunistic data obtained by the Czech biological expedition to Libya in 1999. Material was collected on 30 localities in Libyan provinces Tarabulus (9 localities), Benghazi (10) and Sabha (11), and on four adjacent localities in Tunisia. We recorded two species of frogs and 25 species of reptiles: two species of turtles, two agamids, one chameleonid, seven species of geckos, four species of lacertids, three species of scincids, four species of colubrids and two species of viperids. Records of *Agame impudicus* Boettger, 1874 and *Tarentola neglecta* Strauch, 1895 extend the known ranges of these species. Material of some taxonomically difficult taxa, i. e., *Acanthodactylus aculeatus* (Audouin, 1809) group, genera *Stenodactylus* Fitzinger, 1826 and *Tarentola* Gray, 1825, is discussed.

**Distribution, Amphibia, Reptilia, Sahara, Northern Africa**

### INTRODUCTION

Herpetological research of Libya and adjacent areas in the eastern part of North Africa has very long tradition (e. g., Anderson 1898, Werner 1899a, b, 1909), and a lot of publications provide keys and distributional data (e. g., Loveridge 1947, Kramer & Schnurrenberger 1963, Arnold 1980, 1983, Salvador 1982, Joger 1984a, Blanc 1986). However, recent descriptions of some new species (see Baba El Din 1997, 1999) suggest that the field is still in progress. The basic review of herpetological activities in Libya can be found in Schleich et al. (1996).

It is evident, that the most intensive research effort has been paid to the narrow Mediterranean zone (e. g., Werner 1909, Kramer & Schnurrenberger 1963, Schleich 1987, 1989, Moravec 1995, Fritz & Buskirk 1997). The remaining part of Libya was elaborated only poorly. Consequently, the Great Socialist People's Libyan Arab Jamahiriya has remained the least studied country in the North Africa. The aim of the present paper is to summarize the preliminary results of herpetological research carried out during our trip to Libya in the year 1999.

### MATERIALS AND METHODS

All the animals and records of their occurrence evaluated in this paper were collected by the authors (except of J. M.) and other participants of the Czech expedition. The field trip took place between September 26 and October 15, 1999. In the field, captured individuals were determined, recorded and catalogued by the first two authors (D. F. and L. K.). Most of them were photographed (mostly by M. K.) and/or video-recorded. The specimens selected for university collections (further referred as specimens or material) were killed and stored in 80% alcohol. The remaining ones (further referred as individuals captured) were either released on their native

locality or transported to Prague, and further studied in captivity. Later on, the material was revised and determined by the first three authors (D. F., L. K., J. M.). The material is deposited in the Collections of the Department of Zoology, Faculty of Science, Charles University, Prague (catalogue series CUPAMPHLIB and CUPREPULIB). Catalogue numbers of each specimen are listed below under the Species Account. Names of collectors are given in parentheses.

## LIST OF LOCALITIES

Studied localities are described in the list below and depicted in Fig. 1. Localities were identified by GPS instrument (Magellan 2000). Geographical names and provincial division (regions) are in according with the map of Hajaji (without year).

1. Al Ghazaya, Tarabulus province, 32° 00' N, 10° 49' E, ca 170 m a.s.l., September 27–28, 1999, hamada desert.
2. Nulut, Tarabulus province, 31° 52' N, 10° 59' E, September 28, 1999, ruins of a village.
3. Smawan, Tarabulus province, 30° 14' N, 10° 03' E, September 28, 1999, oasis, desert.
4. village 3 km W of Ghadames, Tarabulus province, 30° 08' N, 09° 29' E, ca 270 m a.s.l., September 28–29, 1999, village and its surroundings.
5. Ghadames, Tarabulus province, 30° 08' N, 09° 30' E, ca 270 m a.s.l., September 28, 1999, ruins of the ancient town.
6. Subratah, Tarabulus province, 32° 48' N, 12° 29' E, October 13–14, 1999, ruins of the ancient town.
7. ca 20 km N of Al Qusbat, Tarabulus province, 32° 43' N, 14° 06' E, October 12–13, 1999, sea level, sandy beach along the sea coast, palm oasis surrounding water spring.
8. Al Khums (= ancient Leptis Magna), Tarabulus province, 32° 38' N, 14° 17' E, ca 10 m a.s.l., October 12, 1999, ruins of the ancient town.
9. wadi 30 km SE of Ash Shwaymil, Tarabulus province, 30° 13' N, 13° 43' E, September 29–30, 1999, wadi and hamada desert.
10. oasis 23 km N of Sabha, Sabha province, 27° 10' N, 14° 33' E, ca 400 m a.s.l., September 30 – October 1, 1999, sandy desert and oasis.
11. Qabroon Lake, Sabha province, 26° 48' N, 13° 32' E, ca 450 m a.s.l., October 1–2, 1999, ruins of a village on the bank of the lake.
12. Al Fjayj, Sabha province, 26° 32' N, 13° 19' E, ca 700 m a.s.l., October 1–2 and October 6–7, 1999, oasis, palmeria, sand dunes.
13. desert near Wadi Matendush, Sabha province, 25° 59' N, 12° 40' E, 570 m a.s.l., October 7, 1999, hamada mixed with sandy desert.
14. Wadi Mathencous, Sabha province, 25° 46' N, 12° 10' E, 530 m a.s.l., October 7, 1999, rocks along the wadi.
15. oasis 2 km E of Al Awaynat, Sabha province, 25° 49' N, 10° 36' E, ca 600 m a.s.l., October 2–3, 1999, oasis and its surroundings along the stream.
16. Akakus Mts., Sabha province, 25° 19' N, 10° 37' E, October 5, 1999, rocks, acacia trees, sandy desert with bushes.
17. Akakus Mts., Sabha province, 24° 49' N, 10° 39' E, October 5, 1999, Tuarog camp, rocks, acacia trees, sandy desert.
18. Akakus Mts., Sabha province, 24° 41' N, 10° 38' E, 790 m a.s.l., October 4–5, 1999, rocks surrounded by sand dunes.
19. Ghat, Sabha province, 24° 58' N, 10° 10' E, ca 630 m a.s.l., October 3–4, 1999, ruins of the ancient town.
20. camping 1 km S of Ghat, Sabha province, 24° 56' N, 10° 11' E, ca 680 m a.s.l., October 3–4, 1999, buildings and surrounding sandy desert.
21. Sabkhat Karkarah, Birqhaz province, 31° 25' N, 20° 01' E, sea level, October 8–9, 1999, coastal dunes and a village.
22. 5 km NE of Daryanah, Birqhaz province, 32° 23' N, 20° 23' E, October 9, 1999, olive trees and wastes along the road.
23. Al Aqrakah (= ancient Tokrah), Birqhaz province, 32° 32' N, 20° 34' E, ca 20 m a.s.l., October 9, 1999, ruins.
24. Addiriah (= ancient Tolmetha or Ptolemaios), Birqhaz province, 32° 43' N, 20° 57' E, ca 30 m a.s.l., October 9–10, 1999, ruins of the ancient town.
25. 5 km W of Al Awaylah ash Sharkiah, Birqhaz province, 32° 33' N, 20° 58' E, ca 400 m a.s.l., October 10, 1999, gardens along the road.
26. 8 km SW of Qasr Libya, Birqhaz province, 32° 36' N, 21° 22' E, October 10, 1999, bushes along the road.



- 27 Qasr Lihya, Benghazi province, 32° 38' N, 21° 24' E, ca 450 m a.s.l., October 10, 1999, archaeological site
- 28 Sluntali, Benghazi province, 32° 36' N, 21° 43' E, ca 640 m a.s.l., October 10, 1999, artificial holes and caves in the rock
- 29 Shabhat (= ancient Cyrene), Benghazi province, 32° 49' N, 21° 52' E, 650 m a.s.l., October 10–11, 1999, ruins of the ancient town
- 30 Susah (= ancient Apollonia), Benghazi province, 32° 54' N, 21° 58' E, ca 10 m a.s.l., October 11, 1999, ruins of the ancient port
- 31 ca 3 km W of Ras Idayr, Libyan-Tunisian border, Tunisia, 33° 09' N, 11° 31' E, ca 10 m a.s.l., October 14, 1999, semidesert along the road
- 32 Chaffar, ca 20 km SW of Sfaxis, Tunisia, 34° 32' N, 10° 35' E, sea level, September 26–27 and October 14–15, 1999, village and sand dunes along the sea coast
- 33 10 km N of Infada, Tunisia, 36° 15' N, 10° 26' E, October 15, 1999, road side
- 34 near Tunis harbour, Tunisia, 36° 48' N, 10° 13' E, October 15, 1999, road side

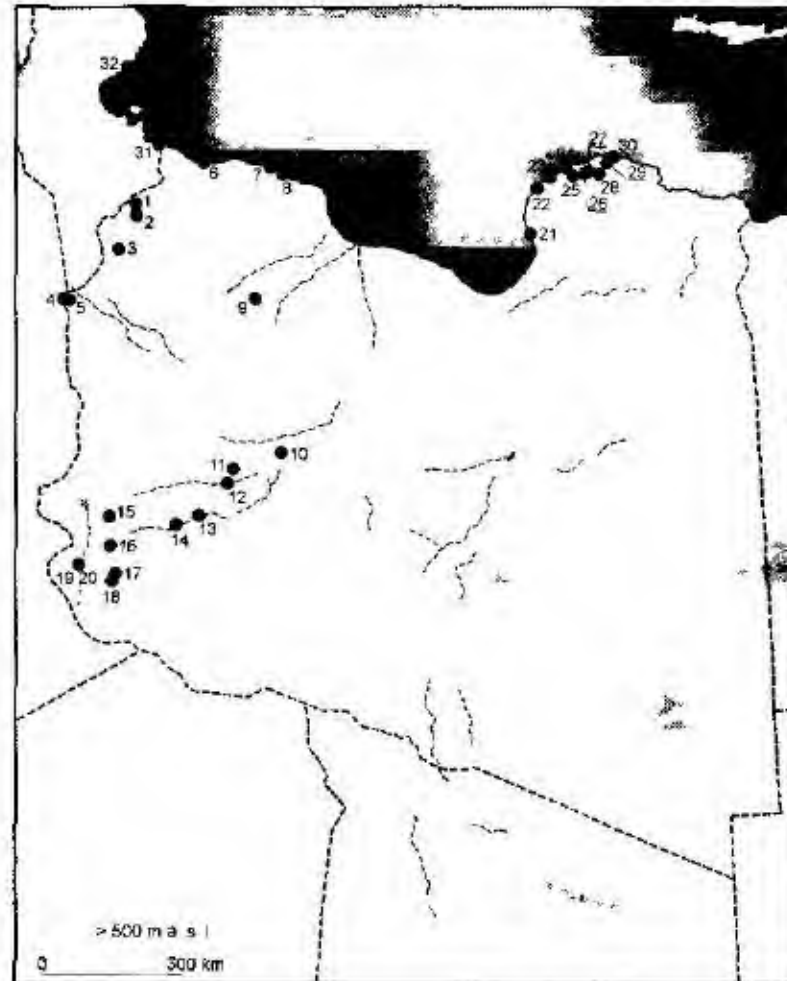


Fig. 1. Map of Libya with the localities of records. For legend see List of localities

## SPECIES ACCOUNT

Amphibia  
Bufonidae

### *Bufo cf. viridis* Laurenti, 1768

RECORDS. Material: 4, 6. Sebratal, 1 spec. (CUP\AMPH\LIB\016, Benda), 1 ind. captured (Kaftan); 11. Gabroon Lake, 1 ind. captured (Kaftan & Schwarzová); 12. Al-Fjayj, 1 ind. captured (Kratochvíl); 29. Shabhat, 1 spec. (CUP\AMPH\LIB\001, Schnal), CUP\AMPH\LIB\015, Kaftan); 32. Chaffar, 1 spec. (CUP\AMPH\LIB\017, Kaftan), 1 ind. captured (Kaftan).

NOTE. A considerable variation of this species was previously reported in Libya, especially in some southern oases (cf. Schleich et al. 1996). Therefore, the present determination of our material should be considered as preliminary.

Ranidae

### *Rana cf. saharica* Boulenger, 1913

RECORDS. Material: 13, 29. Shabhat, 13 spec. (CUP\AMPH\LIB\002–014, Schnal).

NOTE. Schleich (1987) previously reported this species (referred as *Rana "ridibunda"* Pallas, 1771) from the same locality.

Reptilia  
Testudinidae

### *Testudo graeca* Linnaeus, 1758

RECORDS. 26. 8 km SW of Qasr Libiya, 1 ind. found on the road (Lundák) and photographed; 27. Qasr Libiya, 1 ind. found dead (CUP\REPT\LIB\141, Kratochvíl); 1 juv. ind. observed (Kratochvíl); 29. Shabhat, 2 ind. found dead (Schwarzová, Kratochvíl).

NOTE. Schleich (1987) distinguished two forms of this species in adjacent territories of Kouf National Park in the Northeast of Libya. He assigned them to *T. g. graeca* Linnaeus, 1758 and *T. g. terrestris* Forskål, 1775. From Qasr Libiya he reported the nominotypical subspecies.

### *Testudo kleinmanni* Lortet, 1883

RECORD. 8. Al Khams, 1 ind. found dead (Schnal).

NOTE. Our record lies at the western border of the range and supports the recent finding of Fritz & Buskirk (1997) regarding the occurrence of this species in Tripolitania. However, a recent introduction by tourists cannot be excluded because of the extensive pet trade in Libya.

Agamidae

### *Agama impalearis* Boettger, 1874

RECORDS. Material: 4, 14. Wadi Mathendous, 1 spec. (CUP\REPT\LIB\135, Kaftan), 3 ind. captured (Kaftan), 2 ind. captured (Kratochvíl), 1 ind. captured (Frynta); 16. Akakus Mts., 2 ind. captured (Kratochvíl, Frynta); 17. Akakus Mts., 2 spec. (CUP\REPT\LIB\132, Kaftan & Frynta, CUP\REPT\LIB\134, Frynta), 1 ind. observed and photographed (Černý & Kaftan); 18. Akakus Mts., 1 spec. (CUP\REPT\LIB\139, Nový & Frynta).

NOTE. Schleich et al. (1996) reported this species only from the vicinity of Ghat in the extreme Southwest Libya. Our locality No. 14 is situated more than two hundred kilometers further North-East. The occurrence of this species is confined to rocks (localities Nos 14, 16, 17, 18) and acacia trees (locality No. 17). Maximal snout-vent length recorded was 127 mm in the male (No. CUP\REPT\LIB\134). This value fits well the estimates reported for the Moroccan populations (Brown et al. 1999, El Mouden et al. 1999).

***Uromastix acanthinura* Bell, 1825**

RECORD. 18. Akakus Mts, 1 ind. found dead (Kaftan).

NOTE. It is believed that populations from mountain regions of South Sahara belong to a distinct species *U. geyri* Müller, 1922. Our specimen is too damaged to be determined without doubt.

**Chamaeleonidae**

***Chamaeleo chamaeleon* (Linnaeus, 1758)**

RECORDS. 6. Sabratat, 1 ind. observed (Klosová) and photographed. 21. Sabkhat Karkurah, 1 ad. and 1 juv. ind. observed and photographed (Kratochvíl, Sehnal). 29. Shahhat, 2 ind. observed (Schwarzová, Benda) and photographed.

NOTE. All the localities are situated in the Mediterranean habitats, e.g., sand dunes along the sea coast (localities Nos 6 and 21).

**Gekkonidae**

***Hemidactylus turcicus* Linnaeus, 1758**

RECORDS. Material. 6, 23. Al Aqurrah, 1 spec. (CUP\REPT\LIB\034, Frynta). 29. Shahhat, 1 spec. (CUP\REPT\LIB\043, Benda), 1 ind. captured (Kaftan). 30. Susah, 1 spec. (CUP\REPT\LIB\046, Kratochvíl & Klosová). 32. Chaffar, 2 spec. (CUP\REPT\LIB\003, Frynta, CUP\REPT\LIB\004, CUP\REPT\LIB\101, Schwarzová). 5 ind. captured (Frynta), 2 ind. captured (Mikulová), 1 ind. captured (Schwarzová). 33. 10 km N of Intada, 1 ind. captured (Sehnal).

NOTE. All the records were confined to anthropogenous habitats in the Mediterranean zone.

***Ptyodactylus ragazzii* Anderson, 1898**

RECORDS. Material. 12; 18. Akakus Mts, 1 spec. (CUP\REPT\LIB\071, Kratochvíl). 19. Ghat, 2 spec. (CUP\REPT\LIB\080-081, Kratochvíl, Mikulová & Klosová). 20. camping 1 km S of Ghat, 9 spec. (CUP\REPT\LIB\011, Sehnal, CUP\REPT\LIB\072-76, Frynta, CUP\REPT\LIB\077-078, Kaftan, CUP\REPT\LIB\079, Kratochvíl, CUP\REPT\LIB\103, juv., Lundák).

NOTE. High densities of this species in the anthropogenous habitats (localities Nos 19 and 20) contrast sharply with just a single specimen found in a natural rocky habitat (locality No. 18) despite a considerable sampling effort. All the individuals were of light grey-brown colour without any distinct pattern.

***Stenodactylus petrii* Anderson, 1896**

RECORDS. Material. 18, 10. oasis 23 km N of Sabha, 16 spec. (CUP\REPT\LIB\015, CUP\REPT\LIB\017-018, Kaftan, CUP\REPT\LIB\019, Nová, CUP\REPT\LIB\056, CUP\REPT\LIB\082-083, Frynta, CUP\REPT\

LIB086-87, Klosová, CUPAREPTLIB0100, CUPAREPTLIB0115-116, Kratochvíl, CUPAREPTLIB0117-119, CUPAREPTLIB0124, Schwarzová), 2 ind. captured (Lundák, Mikulová); 12. Al'Fjay, 2 spec. (CUPAREPTLIB085, CUPAREPTLIB0138, Kratochvíl), 2 ind. captured (Schwarzová), 20. camping 1 km S of Ghat, 1 spec. (CUPAREPTLIB084, Kratochvíl).

NOTE. Our localities of this sand-dweller species are situated in the Saharan part of Libya. All the individuals were captured on sand dunes covered with very scarce shrubs.

#### *Stenodactylus* sp.

RECORDS. Material. 9. 1. Al Ghazaya, 1 ind. captured (Kratochvíl), 32. Chaffar, 9 spec. (CUPAREPTLIB054, CUPAREPTLIB088, CUPAREPTLIB090-91, Kratochvíl, CUPAREPTLIB0102, Dandová, CUPAREPTLIB0104, Frynta, CUPAREPTLIB0105, Klosová, CUPAREPTLIB0140, Schwarzová), 6 ind. captured (Frynta), 3 ind. captured (Schwarzová).

NOTE. This form somewhat resembling *S. petrii* was found in two localities of North-West Libya and Tunisia. It seems to be distinct according to both morphometry and scalation, however, it has remained unrecognized by recent authors revising or reviewing North African species of the genus *Stenodactylus* Fitzinger, 1826 (e.g., Arnold 1980, Schleich et al. 1996). The systematics, taxonomy, and morphology of this form will be elaborated elsewhere.

#### *Stenodactylus sthenodactylus* (Lichtenstein, 1823)

RECORDS. Material. 10. 1. Al Ghazaya, 3 ind. captured (Frynta, Kratochvíl, Mikulová); 9. wadi 30 km SE of Ash Shwayrif, 4 spec. (CUPAREPTLIB094, Klosová & Schwarzová, CUPAREPTLIB099, Kaftan, CUPAREPTLIB0113-114, Kratochvíl), 1 ind. captured (Kratochvíl); 12. Al'Fjay, 1 spec. (CUPAREPTLIB020, Sebnal), 15. oasis 2 km E of Al Awaynat, 3 spec. (CUPAREPTLIB057, CUPAREPTLIB089, Klosová, CUPAREPTLIB0125, Kratochvíl), 2 ind. captured (Klosová), 3 ind. captured (Schwarzová), 2 ind. captured (Frynta), 1 ind. captured (Kaftan), 21. Sabkhat Karkurah, 2 ind. captured (Frynta), 2 ind. captured (Mikulová, Kratochvíl), 32. Chaffar, 2 spec. (CUPAREPTLIB092, Kratochvíl, CUPAREPTLIB0123, Frynta), 4 ind. captured (Schwarzová).

NOTE. Individuals from the southernmost locality (No. 15) are somewhat slender, having slightly longer tails and legs. The locality is situated near the type locality of *Garzoniella longipes* Perret, 1976 ("probably between Ghat and Sebnal"). Our material fits well the original description of this form which is treated as a junior synonym of *Stenodactylus sthenodactylus*. Traditionally (following Loveridge 1947), two subspecies are recognized (Arnold 1980), the nominotypical one and the *Stenodactylus sthenodactylus mauritanicus* Guichenot, 1850. Taking into account a great variation among individual populations of *S. sthenodactylus* sensu lato it is evident that the situation is much more complex and needs more detailed investigations (see, e.g., Arnold 1980).

#### *Tarentola neglecta* Strauch, 1895

RECORDS. 10. oasis 23 km N of Sabha, 1 ind. captured (Sebnal); 11. Gabroon Lake, 1 ind. captured (Blecha).

NOTE. The localities are situated eastward from the known range of this species (in Algeria) given by Joger (1984a).

#### *Tarentola mauritanica fascicularis* (Daudin, 1802)

RECORDS. Material. 39. 2. Nalut, 1 ind. captured (Benda); 4. village 3 km W of Ghadames, 5 ad. spec. (CUPAREPTLIB009, CUPAREPTLIB010, CUPAREPTLIB012, Frynta & Kratochvíl, CUPAREPTLIB021,

Mikulová, CUPREPTLIB038, Schwarzová), 3 juv. spec. (CUPREPTLIB001, Schwarzová, CUPREPTLIB120, CUPREPTLIB126, Frynta), 2 ad. ind. captured (Frynta & Kratochvíl); 5. Ghadames, 2 juv. spec. (CUPREPTLIB011, Kłosová, CUPREPTLIB012, Schwarzová); 6. Sabratal, 2 juv. spec. (CUPREPTLIB121, CUPREPTLIB142, Kłosová & Schwarzová), 7 ind. captured (Kłosová & Schwarzová); 7. ca 20 km N of Al Qusba, 1 ind. captured (Kaftan); 8. Al Khums, 4 ad. spec. (CUPREPTLIB096–098, Frynta, CUPREPTLIB129, Frynta & Kłosová) and 2 juv. spec. (CUPREPTLIB069, Schnal, CUPREPTLIB106, Schwarzová), 3 ind. captured (1 Kłosová, 2 Kratochvíl); 9. wadi 30 km SE of Ash Shwayrif, 1 ad. spec. (CUPREPTLIB095, Frynta) and 1 juv. spec. (CUPREPTLIB107, Schwarzová), 2 ad. ind. captured (Kaftan); 21. Sabkhat Karkurah, 7 juv. or sad. spec. (CUPREPTLIB030–032, Schnal, CUPREPTLIB062, Kratochvíl, CUPREPTLIB063–064, CUPREPTLIB131, Schwarzová), 4 ad. ind. captured (Schnal), 2 ind. captured (Nový); 22. 5 km NE of Daryanah, 2 juv. spec. (CUPREPTLIB108, Kaftan, CUPREPTLIB109, Frynta); 23. Al Aquriah, 1 ad. spec. (CUPREPTLIB036, Benda), 2 juv. captured (Kratochvíl); 24. Addrsiah, 2 spec. (CUPREPTLIB037, CUPREPTLIB133, Schwarzová), 5 ad. ind. captured (Nová & Kaftan), 2 ad. ind. captured (Frynta), 2 ad. ind. captured (Frynta & Kaftan, Frynta & Kratochvíl), 1 ad. captured (Schwarzová), 5 juv. ind. captured (Kratochvíl); 26. 8 km SW of Qasr Libiya, 1 spec. (CUPREPTLIB070, Kratochvíl); 27. Qasr Libiya, 1 ad. ind. captured (Benda), 1 juv. ind. captured (Kratochvíl & Schwarzová); 28. Siuntah, 1 ind. captured (Benda); 29. Shahhat, 11 ad. and 1 juv. ind. captured (Schnal); 30. Susah, 1 spec. (CUPREPTLIB137, Kratochvíl), 2 ad. ind. captured (Kratochvíl & Nový, Benda), 2 juv. ind. captured (Schnal); 32. Chaffar, 4 spec. (CUPREPTLIB002, Kłosová, CUPREPTLIB066, CUPREPTLIB093, Frynta, CUPREPTLIB122, Mikulová), 2 ind. captured (ad., sad., Mikulová), 2 ind. captured (2 sad., Frynta); 33. 10 km N of Infada, 1 spec. (CUPREPTLIB110, Schnal)

NOTE. Rostral shield reaching nostril was found in a considerable proportion of specimens of our samples from the Western Libya and Tunisia. This phenomenon was reported by Joger (1984a) from coastal areas. He attributed this fact to intergradation between *Tarentola mauritanica fascicularis* and *Tarentola m. mauritanica* (Linnaeus, 1758). In accordance with Joger (1984a) we also recorded slight differences in appearance and coloration between individuals coming from Tripolitania and those from Cyrenaica. In addition to this variation, individuals from interior localities resembled *Tarentola deserti* Boulenger, 1891 either by their pale orange coloration (localities Nos 2 and 9) or an exceptionally large size (localities Nos 4 and 5), nevertheless the counts of their gular scales and subdigital lamellae fell into the variation of *T. mauritanica* (cf. Joger 1984a). Close relatedness of the above species (Joger 1984b) and the lack of data concerning the biology of *T. deserti* (cf., Nettmann & Rykena 1985, Híelen 1993) suggest the need of further investigations of this form. Although the occurrence of *T. deserti* in Libya was reported by Schleich et al. (1996) and Baha El Din (1997), the determination keys were based solely on Algerian material, and therefore, designed to discriminate this species from nominotypical subspecies of *T. mauritanica*.

#### *Tropicolotes tripolitanus tripolitanus* Peters, 1880

RECORDS Material. 7. 1. Al Ghazaya, 1 spec. (CUPREPTLIB005, Schwarzová); 9. wadi 30 km SE of Ash Shwayrif, 2 spec. (CUPREPTLIB006, Frynta, CUPREPTLIB007, Nový); 10. oasis 23 km N of Sabha, 2 spec. (CUPREPTLIB060–061, Schnal); 12. Al'Fjayj, 4 spec. (CUPREPTLIB008, CUPREPTLIB022, CUPREPTLIB058, Schnal, CUPREPTLIB059, Schwarzová).

#### Lacertidae

##### *Acanthodactylus boskianus* (Daudin, 1802)

RECORDS Material. 2. 8. Al Khums, 1 spec. (CUPREPTLIB050, Frynta); 12. Al'Fjayj, 1 spec. (CUPREPTLIB025, Frynta & Kratochvíl), 34 near Tunis harbour, 1 ind. captured (Lundák)

NOTE. This species was captured on sandy substrates in the localities Nos 8 and 12.

***Acanthodactylus scutellatus* (Audouin, 1809)**

RECORDS. Material. 14, 8. Al Khums, 4 spec. (CUPREPTLIB047, Frynta, Kratochvíl, Klosev & Schwarzov, CUPREPTLIB048-049, Frynta, CUPREPTLIB050, Kratochvíl & Frynta); 21. Sahkhat Karkurah, 4 spec. (CUPREPTLIB024, Benda, CUPREPTLIB029, Kratochvíl, CUPREPTLIB033, Kratochvíl, CUPREPTLIB035, Kratochvíl, Schwarzov & Frynta); 12. Al'Fjay, 2 spec. (CUPREPTLIB026-027, Frynta & Kratochvíl); 13. desert near Wadi Mathendous, 1 spec. (CUPREPTLIB028); 16. Akakus Mts., 3 spec. (CUPREPTLIB013-014, Frynta, CUPREPTLIB023, Schwarzov & Kratochvíl); 17. Akakus Mts., 1 ind. observed (Frynta)

NOTE. Determination and taxonomy of populations belonging to *A. scutellatus* group is a difficult matter (see e. g., Blanc 1979, Blanc & Ineich 1985). Moreover, there is a considerable geographic variation within *A. scutellatus* sensu stricto. Individual populations differ considerably according to their body size, coloration and even scalation (Salvador 1982, Arnold 1983). (1) Our specimens from both Mediterranean localities (Nos 8 and 21) have grey coloured slightly dark-spotted back. Those from the former locality are adults of an exceptionally large size (up to 72 mm SVL). (2) Specimens from localities in the Sabha province (Nos 12, 13, 16, 17) are middle sized (up to 55 mm) sandy-orange coloured on the back. Except the black spotted individual from the locality No. 13 their dorsum is pale without clear dark spots or reticulation. They share this character with a sibling species *Acanthodactylus longipes* Boulenger, 1918. However, the arrangement of their supralabials follow the pattern typical for *scutellatus*.

***Mesalina rubropunctata* Lichtenstein, 1823**

RECORDS. Material. 1, 3. Sinawan, 1 spec. (CUPREPTLIB055, Frynta & Blecha)

NOTE. Nasals are in contact behind the rostral in our specimen.

***Ophisops elegans* Mntrs, 1832**

RECORDS. Material. 5, 24. Adarsiah, 2 spec. (CUPREPTLIB039, Frynta & Schwarzov, CUPREPTLIB052, Kratochvíl), 1 ind. observed (Mikulov & Frynta); 26. 8 km SW of Qasr Libya, 1 spec. (CUPREPTLIB040, Kratochvíl); 29. Shahhat, 2 spec. (CUPREPTLIB044-045, Kratochvíl & Frynta, Kratochvíl & Schwarzov), 1 ind. observed (Frynta)

NOTE. We found the species exclusively in Cyrenaica. For the discrimination from *Ophisops occidentalis* Boulenger, 1887 we adopted characters recommended by Chirio & Blanc (1993).

**Scincidae**

***Chalcides ocellatus* (Forskl, 1775)**

RECORDS. Material. 1, 6. Sabraiah, 1 ind. captured (Kaftan); 7. ca 20 km N of Al Qusbat, 1 spec. (CUPREPTLIB053, Schwarzov); 24. Adarsiah (Telmetha), 1 ind. observed (Kratochvíl); 30. Susah, 1 ind. captured (Klosev & Kratochvíl)

NOTE. The individual captured at the locality No. 24 resembles by its darker dorsum and dark lateral stripes the pattern of *C. o. tiligugu* Gmelin, 1788.

***Mabuya vittata* (Olivier, 1804)**

RECORDS. Material. 3, 27. Qasr Libya, 3 spec. (CUPREPTLIB041-042, Frynta, Kratochvíl, CUPREPTLIB067, Schwarzov); 29. Shahhat, 1 ind. captured (Kaftan)



***Sphenops cf. boulengeri* (Anderson, 1896)**

RECORD Material 1, 4. village 3 km W of Ghadames, 1 spec. (CUPREPT\LIB\016, Kaftan)

NOTE Labialia of our specimen were damaged by ants, therefore, the possible confusion with *S. sepsoides* Audouin, 1829 cannot be excluded

**Colubridae**

***Coluber algirus* (Jan, 1863)**

RECORDS Material 1, 27. Qasr Libya, skin found (Kratochvíl), 29. Shakhbat, 1 ind. captured (CUPREPT\LIB\065, Kaftan), 1 ind. captured (Schnal), 2 ind. observed (Mikulova & Frynta, Blecha)

***Spalerosophis diadema cliffordi* (Schlegel, 1837)**

RECORD 11. Ghabraou Lake, 1 ind. captured (Kaftan)

***Malpolon monspessulana insignita* (Geoffroy de St.-Hilaire, 1809)**

RECORDS Material 2, 6. Sabratah, 1 ind. found dead (Benda), 7. ca 20 km N of Al Qusbat, 1 ind. observed swallowing *Trithacus rubecula* (Kaftan) 21. Sabkhat Karkurah, 1 ind. found dead (CUPREPT\LIB\127, Frynta) 25. 5 km W of Al Awayyah ash Sharkiah skin found (Kratochvíl), 28. Sluntah, 1 spec. (CUPREPT\LIB\128, Schwarzová, Frynta & Kaftan)

***Psammophis schokari* (Forskål, 1775)**

RECORD Material 1, 7. ca 20 km N of Al Qusbat, 1 spec. (CUPREPT\LIB\068, Frynta)

**Viperidae**

***Cerastes cerastes* (Linnaeus, 1758)**

RECORDS 1. Al Ghazaya, 1 ind. captured (Kaftan & Blecha), 15. oasis 2 km E of Al Awaynat, 2 ind. captured (Kratochvíl & Frynta, Benda & Kaftan), 31. ca 3 km W of Ras Jdayr, 1 ind. captured (Frynta & Kaftan)

NOTE Specimens from the locality No. 15 were completely or nearly hornless, and lacked conspicuous dorsal pattern

***Cerastes vipera* (Linnaeus, 1758)**

RECORDS 21. Sabkhat Karkurah, 2 ind. captured (Blecha)

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## Microgradient changes of soil nematodes (Nematoda) in litter and moss-lichen transects in spruce and beech forests

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**Abstract.** Distribution of soil nematodes through moss-lichen and litter patches was studied in two transects. The first microgradient represented a moss-litter transect (M-LT) in a spruce plantation; the second microgradient was a moss/lichen-litter transect (M/L-LT) in an original beech forest. M-LT was characterized by relatively low fluctuations in nematode abundance and prevalence of mycophagous and myco-phytophagous nematodes (mmpn) in moss cushion. M/L-LT had greater diversity of nematodes, prominent differences in nematode abundance in individual transect zones and prevalence of mmpn in transitional zone between moss-lichen and beech litter patches. Differences in composition and origin of nematode assemblages in moss litter and moss/lichen-litter patches of spruce and beech forest of the region are discussed.

**Microdistribution, abundance, biomass, diversity, ecotone, nematodes, Central Europe**

### INTRODUCTION

The fact that abundant nematode populations live in moss and lichens is generally known (Zullini 1970, Brzeski 1995) and nematodes in moss are also studied for bioindication purposes (Zullini & Peretti 1986, Steiner 1994a, 1994b). Distribution, abundance, diversity and coexistence of nematodes in forest litter and humus was investigated by many nematologists (Sohlenius 1985, Arpin et al. 1995, Ruess 1995). Attention was also paid to distribution of nematodes in various patches in forest ground (Magnusson 1983). Those papers usually evaluated patchy distribution of nematodes and their preferences for microhabitats. This paper asks another question: how nematode assemblages can change along moss/lichen – litter transects in different ecosystems and whether the transitional zone between moss/lichen and litter patches can exert a (micro)ecotonal effect on nematode populations.

### MATERIAL AND METHODS

The study sites are located in Central Bohemia in the environs of Jevany u Prahy and Černo Vodčrady, about 25 km east of Praha suburbs. 49°58' N, 14°48' E. The area is about 350–500 m a.s.l., sum of precipitation approximates 600–700 mm per year, mean annual temperature varies through 7.0–8.0 °C. Parent rocks are usually granites; soils are mostly acid oligotrophic cambisols, locally pseudogleys and azonal podzols and rankers. Original plant cover mostly belonged to beech forests *Luzuleto-Fagetum* with dominant *Fagus sylvatica* L. and relatively poor understory vegetation. There was also azonal occurrence of spruce *Picea abies* (L.) Kunt. in climatic inversions in valleys along the Jevanský potok stream, which species is recently grown in large plantations.

The first transect was studied in a 40–60 year-old spruce forest plantation near Černo Vodčrady, 350 m a.s.l. This forest was studied for ecotonal effect on soil nematodes by Háníl (1993). To study microgradient changes in nematodes, the block of soil covered by the moss patch of *Pohlia nutans* (Hedw.) Lindb. surrounded by spruce litter

(length 50 cm, width 10 cm, depth 3.5 cm) was removed from the ground and transported to laboratory. Fig. 1 The 1.5 cm wide tape was cut off the block and the tape was divided into ten zones for isolation of nematodes. In the field, the transect was perpendicular to the spruce forest edge exposed to South-West (P1 represented forest edge side, about 20 m from the edge). This stand represented a habitat highly impacted by human activity (silvicultural practices).

The second transect was studied in an old original beech forest *Luzulea Fagetum eladomietosum* (type with *Dicranum scoparium*) on the territory of the Voděradské bučiny Natural Reserve near Jevany u Prahy, 440 m a.s.l. Endominant tree was *Fagus sylvatica* and *Polytrichum formosum* Hedw., *Dicranum scoparium* Hedw., *Leucobryum glaucum* (Hedw.) ngstr., *Cladonia* spp and *Luzula* spp. in understory. The block of ranker soil studied was covered by a patch of moss-lichen carpet (dominant *Dicranum scoparium* and *Cladonia* spp. with sparse tufts of *Polytrichum* sp.) on one side and by a shallow beech litter layer on the other and with almost bare humus patch in its central part (only fragments of beech leaves present), see Fig. 1. Dimensions of the block were as follows: length 60 cm, width 14 cm, depth 3 cm. In the laboratory, 1.5 cm wide tape was cut off the block and divided into twelve zones to study nematodes. The longer side of the block was exposed to North-West on a gentle slope in upper part of the beech forest and exposed to cold winds (because in old beech wood without shrubs). This a top hill phenomenon retarded the succession and development of soil profile to ranker stage (Russek 1993). This stand represented a relic habitat of Pleistocene origin with a low impact of anthropogenic disturbance.

The rest of both block was studied for testate amoebae and microarthropods (Balík 1996, Russek & Stary, unpublished). Samples were taken on 25 November 1986. Nematodes were isolated from samples by the modified Baermann funnel method and processed as described by Hančl (1993).

Several indices were calculated as follows:

– Shannon index of diversity for genera

$H'_{\text{gen}} = -\sum f(k) \times \log f(k)$  – Sum Maturity Index (Yeates 1994)

$MI = v(k) \times I(k)$

### Moss-litter transect



### Moss/lichen-litter transect

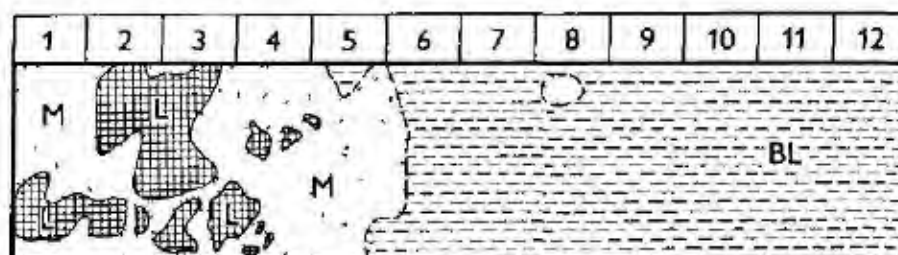


Fig. 1. Sketches of moss-litter transect in spruce plantation and moss/lichen-litter transect in beech wood. M = moss, L = lichen, SL = spruce litter, BL = beech litter

Table 1. Distribution of soil nematode species in samples from moss-litter transect in spruce plantation and moss/lichen-litter transect in beech wood

	moss-litter										moss/lichen litter									
	P	P	P	P	P	P	P	P	P	P	S	S	S	S	S	S	S	S	S	S
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
<i>Lumbrivastera filiformis</i> (Bastian, 1865)											+				+				+	+
<i>Plectus acuminatus</i> Bastian, 1865	+	+		+							+				+					
<i>Plectus geophilus</i> de Man, 1880	+	+	+	+																
<i>Plectus longicaudatus</i> Butschli, 1873	+	+	+	+	+	+	+	+	+	+										
<i>Plectus rhizophilus</i> de Man, 1880	+	+	+																	
<i>Plectus rambesii</i> Micoletzky, 1915	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Wilsonema schuurmanssteekhoveni</i> (De Coninck, 1931)	+	+	+	+	+	+	+	+	+	+	+									
<i>Teratocephalus parietinus</i> Eroshenko, 1973	+	+	+																	
<i>Teratocephalus brellius</i> Anderson, 1969	+	+	+	+	+	+	+	+	+	+	+	+								
<i>Teratocephalus terrestris</i> (Butschli, 1873)	+	+	+	+	+	+	+	+	+	+										
<i>Metateratocephalus crassidens</i> (de Man, 1880)	+	+	+	+	+	+	+	+	+	+	+	+	+							
<i>Heterocephalobus elongatus</i> (de Man, 1880)	+	+																		
<i>Acroboloides nanus</i> (de Man, 1880)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Panagrolaimus rigidus</i> (Schneider, 1866)	+	+	+	+	+	+	+	+	+	+										
<i>Panagrolaimus spondyli</i> Korner, 1954	+	+	+	+	+	+														
<i>Rhabditis terricola</i> Dujardin, 1845	+	+	+	+																
<i>Bunonema reticulatum</i> Richters, 1905	+	+																		
daughters larvae <sup>1)</sup>	+	+	+	+	+	+														
<i>Aphelenchus avenae</i> Bastian, 1865	+																			
<i>Aphelenchoides cyrtus</i> Paesler, 1957	+	+	+	+	+	+	+	+	+	+	+									
<i>Aphelenchoides ferrandini</i> Meyl, 1954	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Aphelenchoides parietinus</i> (Bastian, 1865)	+	+																		
<i>Aphelenchoides saprophilus</i> Franklin, 1957	+	+	+	+	+	+	+	+	+	+										
<i>Aphelenchoides stammeri</i> Korner, 1954 <sup>2)</sup>	+	+	+	+	+	+	+	+	+	+										
<i>Aphelenchoides</i> Fisher, 1894 sp	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Filenchus amaritius</i> Zell, 1988	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Filenchus ditissimus</i> (Brzeski, 1963)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Filenchus longicaudatus</i> Zell, 1988	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Filenchus orbis</i> (Andrassy, 1954)	+	+	+	+	+	+	+	+	+	+										
<i>Filenchus</i> Andrassy, 1954 sp. 1	+	+	+	+	+	+	+	+	+	+	+									
<i>Filenchus</i> Andrassy, 1954 sp. 2	+	+	+	+	+	+	+	+	+	+										
<i>Leilenchus leptosoma</i> (de Man, 1880)	+	+	+																	
<i>Tylenchus davami</i> Bastian, 1865	+	+	+	+	+															
<i>Malenchus bryophilus</i> (Steiner, 1914)	+	+	+	+																
<i>Malenchus exiguus</i> (Massey, 1969)	+	+	+	+	+	+	+	+	+	+										
<i>Cephalenchus hexalincatus</i> (Geraert, 1962)	+	+	+	+	+	+	+	+	+	+										
<i>Ditylenchus</i> Filipjev, 1936 sp	+	+	+																	
<i>Deladenus</i> Thorne, 1941 sp	+																			
<i>Alaimus parvus</i> Thorne, 1939	+	+																		
<i>Alaimus primitivus</i> de Man, 1880	+	+																		
<i>Prismatolaimus intermedius</i> (Butschli, 1873)	+	+	+																	
<i>Eudorylaimus silvaticus</i> Brzeski, 1960 <sup>3)</sup>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Eudorylaimus</i> Andrassy, 1959 sp	+																			
<i>Aporcylaimellus obtusicaudatus</i> (Bastian, 1865)	+	+	+																	
<i>Tylencholaimus aurabitis</i> (Butschli, 1873)	+	+	+	+	+	+														

<sup>1)</sup> probably mostly infective stages of *Steinernema* Travassos, 1927, <sup>2)</sup> systematic position of species unsettled, either placed in *Aphelenchoides* or in *Etiaphelenchus* Fuchs, 1937 (Hunt 1993), <sup>3)</sup> in moss-litter transect probably also some individuals of *Microdorylaimus parvus* (de Man, 1880) with juvenile stages indistinguishable from *Eudorylaimus silvaticus*

Table 2. Abundance of nematode genera (ind cm<sup>-1</sup>) in moss-litter transect in spruce plantation. B = bacteriophages, M = mycophages, M-P = myco-phytophages, O = omniphages, IND BIOMASS = mean biomass of an nematode individual in a assemblage

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	AVG	D[%]
1 <i>Filenchus</i> M-P	21.3	36.5	53.2	97.2	109.7	39.4	47.7	66.4	90.3	42.8	60.4	34.2
2 <i>Aphelenchoides</i> M	31.0	31.0	23.5	29.6	43.4	14.5	57.4	63.6	86.2	27.6	40.8	23.1
3 <i>Acrobeloides</i> B	14.5	33.7	51.8	4.1	17.2	6.9	24.9	36.7	79.3	80.7	35.0	19.8
4 <i>Plectus</i> B	6.9	7.6	2.1	11.7	11.7	6.9	15.2	15.2	20.7	14.5	11.2	6.4
5 <i>Eudorylaimus</i> O	8.9	8.3	8.3	13.1	6.9	9.7	15.2	5.5	8.3	9.7	9.4	5.3
6 <i>dauer larvae</i> B	0	0	0	0	6.2	21.4	32.5	12.4	4.1	1.4	7.8	4.4
7 <i>Wilsonema</i> B	3.4	8.3	0	0	2.1	1.4	5.5	3.5	1.4	5.5	3.1	1.8
8 <i>Malenchus</i> M-P	6.2	8.9	10.4	4.8	0	0	0	0	0	0	3.0	1.7
9 <i>Teratocephalus</i> B	0.7	1.4	1.4	0	2.1	0	0.7	4.8	7.6	11.0	3.0	1.7
10 <i>Metateratocephalus</i> B	0	2.1	1.4	0.7	0	0	0	2.8	1.4	0.7	0.9	0.5
11 <i>Panagrolaimus</i> B	1.4	0.7	0	0	0	0	0	2.1	1.4	0	0.6	0.3
12 <i>Ditylenchus</i> M	0	0.7	2.1	2.8	0	0	0	0	0	0	0.6	0.3
13 <i>Bunonema</i> B	0	0	0	0	0	0	0	0	2.1	0.7	0.3	0.2
14 <i>Alaimus</i> B	0.7	0	0	0	0	0	0	0	0	1.4	0.2	0.1
15 <i>Heterocephalobus</i> B	0	0	0	0	0.7	0	0	0	0.7	0	0.1	0.1
16 <i>Aphelenchus</i> M	0	0	0	0	0	0.7	0	0	0	0	0.1	0.0
17 <i>Prismatolaimus</i> B	0	0	0	0	0	0	0	0	0.7	0	0.1	0.0
ABUNDANCE ind cm <sup>-1</sup>	95	139	154	164	200	101	199	213	304	196	176.5	
BIOMASS µg cm <sup>-1</sup>	11.8	13.9	15.3	12.9	14.6	18.1	32.2	20.3	24.0	20.9	18.4	
IND BIOMASS µg	0.12	0.10	0.10	0.08	0.07	0.18	0.16	0.10	0.08	0.11	0.11	
% of adults	43.5	42.6	33.2	51.7	43.5	31.5	29.2	36.7	35.6	29.6	37.7	
number of species	18	20	15	15	14	14	15	18	22	16	16.7	
H'spp	2.54	2.27	2.09	2.26	1.86	2.07	2.34	2.32	2.12	1.99	2.19	
number of genera	10	11	9	8	9	8	8	10	13	11	9.7	
H'gen	1.83	1.86	1.56	1.30	1.38	1.66	1.77	1.73	1.63	1.69	1.80	
MI	2.20	2.14	2.13	2.16	2.05	1.98	1.99	2.02	2.06	2.16	2.08	
HMIgen	4.15	4.14	3.52	3.02	2.93	3.44	3.65	3.58	3.48	3.87	3.86	
HMI - H'	2.32	2.28	1.96	1.72	1.55	1.78	1.89	1.85	1.84	2.18	2.06	

Heterogeneity Maturity Index (Hančl 1996)

$$HMI_{gen} = -v(k) \times f(k) \times \log f(k)$$

This index evaluates heterogeneity in life strategies of groups of nematode individuals (genera in this study) in a community (assemblage). Higher  $HMI_{gen}$  -  $H'_{gen}$  values than MI can indicate persisting habit of an assemblage (populations maintain their densities to persist in habitat, in comparatively low total nematode abundance the value can indicate stagnation in development of an assemblages or populations dying out). Lower  $HMI_{gen}$  -  $H'_{gen}$  values than MI can indicate colonizing habit of an assemblage (some populations in an assemblage multiply intensively than others and colonize habitat under study). Approximately equal  $HMI_{gen}$  -  $H'_{gen}$  and MI values indicate steady-stating habit of an assemblage (populations develop without extreme increase or decrease in density).

$v(k)$  = e-p value of a nematode taxon (k)  $f(k)$  = frequency of a nematode taxon (k). The e-p values (according to Bongers 1990) vary in the range of 1 to 5 and denote life strategies of nematodes. Colonizers (c, e-p value 1) represent r-strategists in the loose sense with a short life-cycle, persisters (p, e-p value 5) represent K-strategists with a long life cycle. Theoretically, the higher values of maturity indices the higher proportion of persisters and the less degree of disturbance of a nematode community (assemblage).

M/B ratio (Twin 1974)

This is the ratio between mycophagous (M, M-P, O(M) in Tables 2 and 3) and bacteriophagous nematodes (B).

Principal component analysis (PCA) was performed by the program CANOCO (ter Braak 1987), abundance data were  $\log_2(y+1)$  transformed.



## RESULTS

### Moss-litter transect in spruce plantation

The distribution of 30 nematode species through transect is given in Table 1, abundance of genera in Table 2. The genera *Filenchus* (Andrássy, 1954), *Aphelenchoides* Fischer, 1894, *Plectus* Bastian, 1865, and *Eudorylaimus* Andrassy, 1959 represented nematodes typical for all parts of micro-gradient transect. *Malenchus* Andrassy, 1968 was present in spruce litter and partly in moss samples P1, P2, P3, and P4 but was absent on the other side of the transect in opposition to *dauer larvae* (probably invasive larvae of *Steinernema* Travassos, 1927 sp.) *Teratocephalus* de Man, 1876, *Metateratocephalus* Eroshenko, 1973, *Panagrolaimus* Fuchs, 1930, and *Ditylenchus* Filipjev, 1936 preferred spruce litter to moss patch. *Acrobeloides* (Cobb, 1924) also declined in some part of moss.

Moss cushion represented less suitable habitat for some nematodes and also divided litter nematode assemblage in two sub-groups. This situation is depicted by ordination diagrams (Fig. 2). The cluster of samples P1, P2, P3, and P4 is characterized by *Malenchus*, the cluster of samples P5, P6, P7, P8, P9, and P10 by *dauer larvae*.

Abundance of nematodes varied from 95 to 304 with average value of 176.5 ind cm<sup>-2</sup>. Samples P6, P7, P8, P9, and P10 tended to have greater total nematode biomass but mean biomass of a nematode individual in the assemblage showed no prominent changes through transect. Greater values of M/B ratio were in samples P4 and P5.

### Moss/lichen-litter transect in beech wood

This transect harbored 32 species (Tab. 1). Most nematodes belonged to the genera *Filenchus*, *Teratocephalus* and *Aphelenchoides*, less dominant genera to the genera *Plectus*, *Eudorylaimus* and *Malenchus* (Tab. 3). Their proportions changed through transects. The left part of ordination gradient (Fig. 2) consists of samples from the moss/lichen carpet. *Tylenchus* Bastian, 1865 occurred only in moss/lichen and this microhabitat was also preferred by *Malenchus*, *Aphelenchoides*, and *Plectus*. *Teratocephalus*, *Eudorylaimus* and *Filenchus* had a maximum of their individuals in moss/lichen but occurred through all samples.

Total abundance of nematodes reached maximum values in moss/lichen, minimum abundance was in samples S8 and S7, similar trend appeared in nematode biomass. Mean biomass of a nematode individual was similar through the transect (0.06–0.17 g) except for S11 (0.30 g). M/B ratio increased in S4, S5 and S6, higher values of diversity and maturity indices were in S1 and S2.

## DISCUSSION

Moss/lichen-litter transect represented a kind of original understory patches in beech forests as formed in post-glacial era in the area studied. Similar combination of nematode genera can be found in some moss and lichen tundras. For example, Kuz'min (1972) found eudominant *Teratocephalus* nematodes in climax tundra in Taimyr. *Teratocephalus* with *Aphelenchoides*, *Plectus*, *Tylenchus*, *Eudorylaimus* dominated in Signy Island moss, maritime Antarctic (Caldwell 1981). In the landscape surveyed, tundra-like moss and lichen formations persisted until now in such wind-blown habitats exposed to the North as the beech wood studied. These ecosystems contain a relic soil animal community of Pleistocene origin (at least since the last continental glaciation) that is characterized by the arcto-alpine or alpine Collembola (Rusek 1993), such phenomenon could be also seen in Nematoda. It is also evident that moss/lichen-litter transect had greater variety of nematodes as concerned their taxa and distribution in individual zones than patches in spruce forest.

Moss-litter transect in spruce plantation represented a derived kind of patches which extended with spruce plantations. In this transect, *Tylenchus* was not found and *Teratocephalus* and *Malen-*

Table 3. Abundance of nematode genera (ind cm<sup>-1</sup>) in moss/lichen litter transect in beech wood. B – bacteriophages, M – mycophages, M/P – myco-phytophages, O – omniphages, IND, BIOMASS – mean biomass of nematode individual in an assemblage.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	AVG	D [%]
1 <i>Filenchus</i> M/P	79.5	47.6	18.9	39.3	31.8	45.0	16.0	13.7	13.7	40.3	36.7	31.8	34.5	27.6
9 <i>Tetratocephalus</i> B	38.0	99.4	23.0	11.7	11.8	15.9	6.3	5.5	10.3	7.0	47.1	31.8	25.7	20.5
2 <i>Aphelenchoides</i> M	105.0	47.6	23.0	10.3	9.7	13.8	3.5	0.7	6.9	7.0	9.0	7.6	20.3	16.2
4 <i>Plectus</i> B	51.8	38.0	34.2	2.1	3.5	0.7	4.2	2.0	2.1	3.5	2.1	0.7	12.1	9.6
5 <i>Eudorylamus</i> O	11.7	12.4	6.3	13.8	7.6	9.0	6.3	0	6.2	2.8	10.4	10.4	8.1	6.4
8 <i>Mulenchus</i> M/P	10.4	46.2	11.2	14.5	5.5	0	0	0.7	4.8	0.7	1.4	0.7	8.0	6.4
3 <i>Acrobeloides</i> B	17.3	5.5	4.2	3.4	2.8	1.4	4.2	1.4	10.3	3.5	1.4	4.2	5.0	4.0
18 <i>Cephalenchus</i> M/P	4.1	5.5	0	1.4	2.1	1.4	1.4	2.0	4.1	0	6.9	0	2.4	1.9
10 <i>Metatetratocephalus</i> B	1.4	2.8	0	0	1.4	0	1.4	0.7	0	4.2	4.2	9.7	2.1	1.7
19 <i>Tylencholaimus</i> O(M)	1.4	0	0	0	4.8	7.6	1.4	0	0	0	4.9	1.4	1.8	1.4
20 <i>Tylenchus</i> M/P	9.0	3.5	2.1	2.8	2.1	0	0	0	0	0	0	0	1.6	1.3
11 <i>Panagrolaimus</i> B	0	1.4	3.5	0.7	2.1	2.1	0	0	0.7	0.7	0	0	0.9	0.7
21 <i>Luniohystera</i> B	0.7	0	0	0	0	0	3.5	0	0	2.8	1.4	0	0.7	0.6
22 <i>Ielenchus</i> M/P	0	0	0	0	4.2	2.1	0	0	0	0	1.4	0	0.6	0.5
7 <i>Wohlfahrtia</i> B	0	2.1	4.2	0	0	0	0	0	0	0.7	0	0	0.6	0.5
23 <i>Aporocleimellus</i> O	0.7	0	0	0	0	0	0	0	0	0	2.8	0.7	0.3	0.3
24 <i>Rhabditis</i> B	1.4	0	0.7	0	0.7	0	0	0	0	0	0.7	0	0.3	0.2
14 <i>Alaimus</i> B	0.7	0	0.7	0	0	0	0	0	0	0	0	0	0.1	0.1
17 <i>Prismatolaimus</i> B	0	0	0	0	0	0	0	0.7	0	0	0.7	0	0.1	0.1
25 <i>Dicladocera</i> M	0	0	0	0	0	0	0	0.7	0	0	0	0	0.1	0.0
ABUNDANCE ind cm	333	312	132	100	90	99	48	28	59	73	131	99	125	3
BIOMASS µg cm	36.2	26.2	14.0	13.1	10.0	10.9	6.5	1.6	6.2	5.3	39.0	16.7	15.5	
IND. BIOMASS µg	0.11	0.08	0.11	0.13	0.11	0.11	0.14	0.06	0.11	0.07	0.30	0.17	0.12	
% of adults	48.3	46.0	33.0	60.7	54.6	55.9	50.7	39.0	32.6	53.3	54.0	54.6	48.6	
number of species	22	18	18	13	20	14	12	12	11	16	20	13	15	8
H spp	2.36	2.15	2.42	1.94	2.38	1.83	2.11	1.70	2.07	2.39	2.17	1.95	2.12	
number of genera	15	12	12	10	14	10	10	10	9	11	15	10	11	5
H gen	1.88	1.90	2.03	1.79	2.15	1.66	2.01	1.65	1.99	1.61	1.89	1.69	2.11	
MI	2.20	2.40	2.25	2.39	2.39	2.48	2.41	2.24	2.37	2.18	2.68	2.68	2.37	
HMI gen	4.33	4.43	4.58	4.35	5.24	4.36	4.94	3.80	4.71	3.69	5.10	4.66	5.07	
HMI H	2.45	2.54	2.55	2.56	3.09	2.70	2.93	2.15	2.72	2.08	3.21	2.98	2.96	
M/B	1.87	1.01	0.78	3.81	2.50	3.10	1.07	1.73	1.26	2.16	0.96	0.87	1.42	

*chus* declined and changed in species. *Filenchus*, *Aphelenchoides*, *Plectus*, *Eudorylamus*, and *Acrobeloides* are ubiquitous genera in various ecosystems of the Czech Republic (Haněl 1993a). Higher abundance of *Acrobeloides* in the spruce forest is in accordance with results that the abundance or dominance of this genus can increase with disturbance of ecosystems (Haněl 1993b; Wasilewska 1991). The species of the genus *Acrobeloides* have a short life cycle (Nicholas 1962; Sohlenius 1973), can increase abundance over a broad range of soil moisture and temperature (Sohlenius 1985), survive well dehydration (Nicholas & Stewart 1989) and can feed on a broad spectrum of microflora (Popovici 1973; Ruess & Dighton, 1996). *Acrobeloides* belongs to colonizers with c-p value equalling 2 (Bongers 1990) which are generally conceived as bio-indicators of habitat disturbance.

We could also see range of values of diversity and maturity indices in beech and spruce stands studied. H'gen (1.61–2.15 and 1.30–1.86, respectively), MI (2.18–2.68 and 1.98–2.20), HMI (3.69–5.24 and 2.93–4.15). All three indices reached higher values in beech stand which meant higher

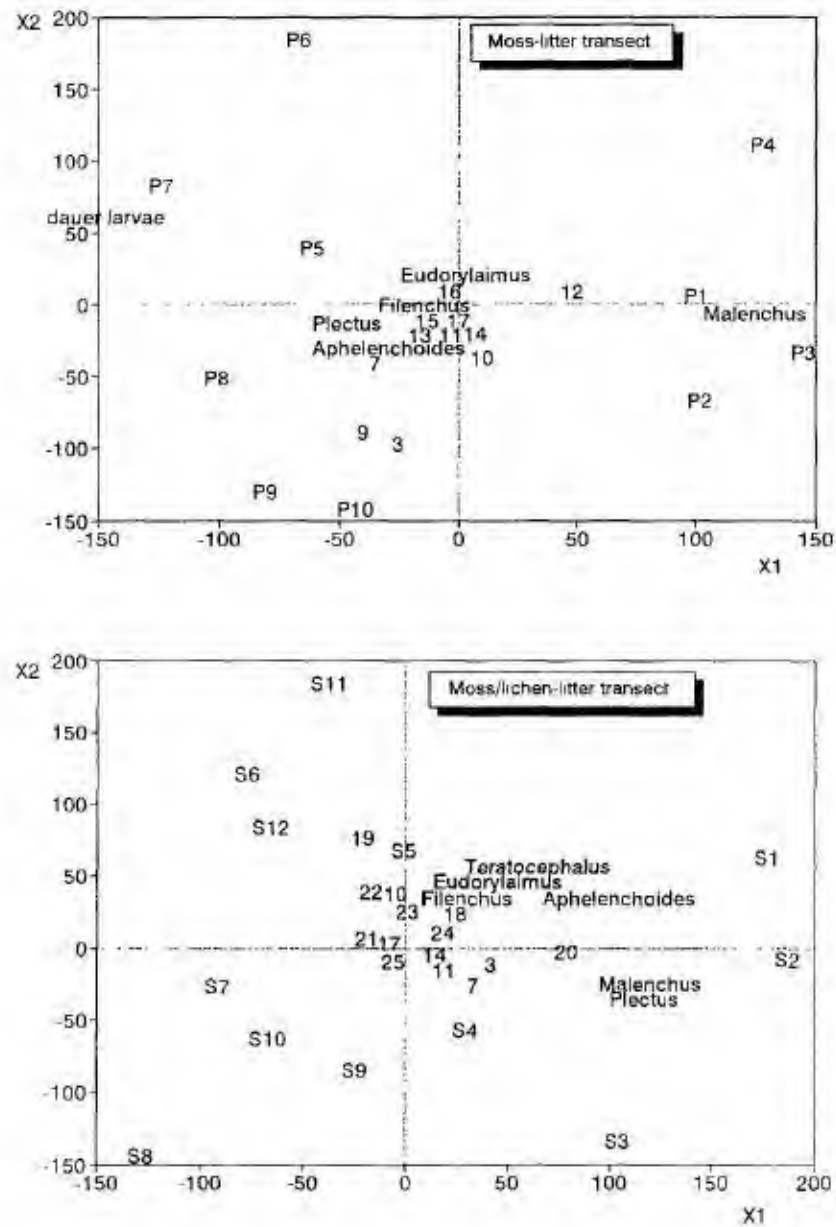


Fig. 2. Ordination (PCA, covariance biplots) of samples and genera of soil nematodes in moss-litter transect in spruce plantation (eigenvalues X1 0.46612, X2 0.25955, X3 0.10111, X4 0.05424) and moss/lichen-litter transect in beech wood (eigenvalues X1 0.48109, X2 0.16513, X3 0.09638, X4 0.06761); numbers coding less abundant genera explained in Table 2 and Table 3.

heterogeneity and proportion of persisters in nematodes, and, this way, less degree of anthropogenic disturbance than occurred in spruce plantation. This conclusion can also be supported by the occurrence of *Steinernema dauer larvae* (invasive stages) in spruce stands. These larvae invade various insects and release entomopathogenic bacteria into the insect body. Bacteria feed on insect tissues, steinernematid nematodes feed on bacteria, mature, reproduce, and invasive larvae migrate from insect to soil after its death (Weiser & Mraček 1988). The occurrence of *Aphelenchoides stammeri* can also be related to insect pests. Korner (1954) described this species with larvae associated with *Spondylis buprestoides* (Linnaeus, 1758) and the species of the genus *Ektaphelenchus* (Fuchs, 1937) are generally known as associates with scolytid beetles (Hunt 1993). Spruce plantations (in fact, patches of disturbance in naturally formed landscape) are susceptible to greater damage from insect pests and to higher occurrence of steinernematid and some aphelenchid nematodes. Therefore, the first conclusion could be that composition of nematode assemblages in the patches of transects reflected historical changes in landscape development.

The second question concerned microgradient changes in the composition of nematode assemblages in individual transects. In the moss-litter transect, MI values varied from 1.98 to 2.20 (2.08 for average abundance) and HMI-H' values changed from 1.55 to 3.32 (2.06 for average abundance). It can be supposed that there were low differences in reproduction rates of nematode assemblages through the transect at the time of the study. This is also seen in relatively low fluctuations in total nematode abundance (Table 2). Moss cushion was characterized by a lower number of nematode genera and by a greater proportion of mycophagous and myco-phytophagous populations (in P4 and P5). Nematode assemblages in litter seemed to be more diversified in taxonomic composition as well as in feeding habits. The reason of this difference could be in greater moisture and temperature fluctuations in moss (protruding over the ground) than in litter. The transect was oriented with P1-side to the edge of the spruce forests and the edge is exposed to the South-West (see Hančl 1993). *Dauer larvae* were found in the opposite P10-side and steinernematid invasive stages are known to survive better in wet than in dry soil. Moisture problem was probably not so crucial for *Malenchus* as they occurred on P1-side. *Malenchus* nematodes probably fed on some kind of fungi (or mycorrhizae) on this P1-side of transect. Therefore, exposition to cardinal points (sunshine) could be an important factor influencing shift in nematode assemblages; this transect however inside the spruce plantation the moss-litter transect was hidden.

The moss/lichen-litter appeared more complicated. MI values varied from 2.18 to 2.68 (2.37 for average abundance) and HMI-H' ones from 2.15 to 3.21 (2.96 for average abundance). Such situation looked like a stagnation of nematode population development at least in some parts of the transects (S5, S11, S7) at the time of sampling. This could be supported by a higher proportion of adult specimens (compare Tab. 2 and Tab. 3). Variation in the constitution of nematode assemblages is also visible in fluctuations of abundance, biomass and number of genera. Taking results of PCA analysis into consideration, S1, S2, S3, and S4 harbored nematode assemblages typical for moss/lichen patch (*Tylenchus*, *Malenchus*, *Plectus*, *Aphelenchoides*, *Teratocephalus* in optimum), S5 represented a transient zone to litter (*Lelechus* Andrassy, 1954, *Tylencholaimus* de Man, 1876). Zone S6 – S12 represented litter patch but with variable nematode assemblages, their composition and development was probably influenced by activity of soil and mycorrhizal microflora as to the differences in M/B ratio. There could also act a competition with testate amoebae, studied simultaneously by Balík (1996). *Tracheleuglypha acolla* Bonnet et Thomas, 1955 and *Corythion pulchellum* Penard, 1890 dominated in parts of litter patch corresponding to zones S9, S10 and S11, *Euglypha rotunda* Wailes et Penard, 1911 in S10 and S11, *Corythion dubium* Taranek, 1881 and *Tritema lineare* Penard, 1890 in S5, S6 and S7.

Balik (1996) studied the two transect for a possible microecotonal effect of moss-litter boundary on Testacea. He found that the ecotonal effect was more pronounced in spruce forest soil than in beech forest soil and that in beech forest there were microecotones likely between moss and lichen than between soil and moss. As concerned nematodes, nothing like ecotonal effect similar to that observed between meadow and spruce forests (Háněl 1993) was found in moss-litter transect in spruce plantation.

In moss/lichen-litter transect in beech forest something like a "zone of transition" could be detected in samples S5-S6-S8 but hardly could be labelled "(micro)ecotonal zone" in a strict sense with the present data. On the other hand, differences in composition of nematode assemblages along the transect were prominent and indicated a great influence of microhabitat with specific macro- and microflora on soil nematodes. As to the exposition to cold winds concerns, microclimate variations in temperature and moisture in moss/lichen and litter patches could also act their part in formation of nematode assemblages in different zone of the microgradient studied. The effect of microhabitats on formation of nematode communities in spruce and beech forest ecosystems will be discussed in next studies.

## CONCLUSION

Soil nematode assemblages in moss- and moss/lichen-litter transects differed in species composition and proportions of genera. These differences mainly reflected landscape development. Moss/lichen-litter transect in original beech stand harbored more diverse nematode assemblages with some relic characters than moss-litter transect in spruce plantation. Microgradient changes in nematode assemblages were detectable, however, their identification with a micro-ecotonal effect was problematic.

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## Seasonal changes of abundance, sex ratio and egg production of *Scheloribates laevigatus* (Acari: Oribatida) in the soil of a meadow in the Czech Republic

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**Abstract.** Populations of the oribatid mite *Scheloribates laevigatus* (C. L. Koch, 1835) were studied on two meadows in Central Bohemia with two and three study plots, respectively, from October 1992 to September 1993. The plots represented different parts of the meadows, differed in humidity and vegetation. The abundance of *S. laevigatus* was different among plots, the mean numbers fluctuated from 3 to 11 individuals per core (cylindrical 5 cm in diameter and 5 cm high). Abundance values fluctuated seasonally but there were no similar trends on observed plots. Abundance maxima were in different months on studied plots. The mean number of abundance fluctuated from 13 to 25 individuals per core during these months. The aggregation trends were positively correlated with abundance. The eggs were observed in the female's oviducts during all observed period. The maximal number of eggs in one female was 11. The number of eggs per gravid females differed on studied plots and fluctuating during season. High proportion of females were larviparous, number of larviparous females increased together with increasing number of gravid females. The mean number of eggs per core differed among studied plots (from 6.1 to 12.7 eggs per sample). The oviposition were not observed directly, but were indicated indirectly using changes in numbers of eggs per female or gravid female, ratios gravid females / barren females and observation of high proportion females having low number of eggs in their oviducts. The first oviposition took place from November to December on all observed plots, the second from June to August was smaller. After the first oviposition changes ratio male / female indicating, the females died after this oviposition. The results from observation of outdoor population are discussed in comparison to results of laboratory observation.

**Ecology, meadow, heterogeneity, egg, seasonal changes, oribatid mites, *Scheloribates laevigatus*, Bohemia**

### INTRODUCTION

Oribatid mites represent an important component of the soil fauna. They are together with springtails important for the soil ecosystems for the following reasons: (1) They consume fungi and bacteria, influencing their communities composition and their fitness (Hanlon 1981, Behan-Pelletier & Hill 1983, Seastedt 1984). (2) They distribute propagules of microorganisms through their faecal pellets, and also simply by moving through the soil, with propagules on their body surface (Behan-Pelletier & Hill 1978, Behan-Pelletier & Hill 1983). (3) They consume litter, and produce faecal pellets that increase the active surface of the litter, enhancing its colonisation by microorganisms that decompose it (e.g. Novák et al. 1959, Behan-Pelletier & Hill 1983). However, the importance of oribatid mites in the soil has not read up yet. The research of autecology of oribatids is necessary to understand decomposition processes in the soil.

*Scheloribates laevigatus* (C. L. Koch, 1835) is the most common oribatid in a meadow soils (e.g., Woodring & Cook 1962, Černová & Čugunová 1967, Baur et al. 1996) and this species is reported as the most frequent species acting as intermediate host of anoplocephalids (Denegri 1993).

*S. laevigatus* belongs to panphytophagous oribatid mites (Luxton 1972), i.e. to oribatid mites able to consume both microorganisms and plant remains. Siepel & Ruther-Dijkmann (1993) classified this species on the basis of their study of digestive enzymes (trehalase and chitinase) as a fungivorous grazer, able to digest both cellular membranes and intracellular matter of the fungi. In addition, *Scheloribates laevigatus* was found to consume spores of the fungal mycelium and spores of *Penicillium griseofulvum* Dierckx, 1901, and the green bark algae *Protococcus viridis* Agardh, 1824 (syn. *Desmococcus vulgaris* Brad, 1925 emend. Genter, 1942) and some plant litter (Hubert et al. 1998).

This paper seeks to contribute to the knowledge on autecology of *Scheloribates laevigatus* in soil of two meadows, on five plots with different vegetation, respectively. Heterogeneity in the abundance of the species will be studied: (a) between plots, (b) within plots during a season in a comparison of eggs production, (c) within plots between samples.

## MATERIAL AND METHODS

### Study plots

Both studied meadows lay near the Říčany town, ca. 20 km east of Praha (Central Bohemia), in the quadrate Nr 6054 (Pruner & Mlýn 1996). Both meadows are ca. 420 m<sup>2</sup> s<sup>-1</sup>.

I. The Tehovec meadow is located at the eastern border of the Vojkov village, east of Říčany. Its area is ca. 5 ha, regularly mowed in June and August. The meadow borders on two sides with a field, while an apple-tree plantation forms on the western border. The northern border of this meadow is formed by a road, behind which there is a spruce forest. Two plots were selected on this meadow. Plot Nr 1 was mesophytic part in the centre of the meadow, with a poor developed moss layer. The following plant species had highest coverage in the herb layer: *Hypericum maculatum*, *Luzula campestris*, *Sanguisorba officinalis*, and *Scorosema humilis*. Plot Nr 2 was a mesophytic part about 10 m from the plot Nr 1, with a poor developed moss layer. The following plant species had highest coverage in the herb layer: *Lychnis flus-cuculi*, *Potentilla erecta*, and *Sanguisorba officinalis*.

II. The Vojkov meadow is located at the western border of Vojkov village, 3.5 km east of Říčany. Its area is ca. 3 ha. It is mowed in June and August. The meadow is surrounded with a mixed forest, its southern border is lined with a brook. Three plots were studied. Plot Nr 3 was located ca. 8 m from the forest edge about 20 m from plot Nr 4 and 35 m from plot Nr 5. Forest litter arrives at the plot irregularly, and in small amounts only. This part was medium dry, with a well developed moss layer. The following plant species had highest coverage in the herb layer: *Geranium palustre*, and *Selinum carvifolia*. Plot Nr 4 was a moist part in the centre of the meadow, with a well developed moss layer. Moss community was rich there in comparison with other plots studied. The following plant species had highest coverage in the herb layer: *Juncus filiformis*, *Lathyrus pratensis*, *Ranunculus repens*, and *Scirpus sylvaticus*. Plot Nr 5 was a dry part, ca. 3 m from the forest edge, and 40 m from the plot Nr 4. The moss layer was poorly developed, and the plot was covered with a layer of oak litter (from a nearby tree growing at the forest edge). The plant community included only a few species. The highest coverage was achieved by *Holcus lanatus*. Two goats were occasionally grazing here from June 1993 till the end of the study.

### Sampling and extraction

The meadows were visited once per month from September 1992 to September 1993. Samples were taken from the soil surface using Kopecký cylinder (i.e. a cylindric steel punch, diameter 5 cm, 5 cm high, with a volume of 100

Tab. 1. Comparison of abundance of *Scheloribates laevigatus* (C. L. Koch) among studied plots. Maximum of abundance is per sample. Abbreviation used: Cv – variation coefficient, n – abundance, X – in column shows no significant differences.

Plot	mean N	max N	Cv	log <sub>e</sub> (N+1)	group
Nr 1	6	27	98,7	1,57	X
Nr 2	10	41	88,8	2,06	X
Nr 3	11	52	81,6	2,25	X
Nr 4	7	58	132,8	1,52	X
Nr 5	3	29	167,8	0,89	X

cm<sup>2</sup>). Each plot measured ca. 1.5×2 m. From each plot, 12 samples were taken, organised in a lattice of 4×3 points. This schema was applied to the plots Nr 1–4. On the other hand, the lattice was 2×6 in the plot Nr 5, being perpendicular to the forest border. Neighbouring points were 45 cm from one another in each case.

Soil samples were extracted in the Berlese-Tullgren apparatus (35°C, 7 days) in the 10% solution of Ajatin (solution of KI and I<sub>2</sub> in distilled water). Extracted oribatids were transferred to 80% ethanol. Juvenile individuals were neither identified, nor considered further.

Sex and the numbers of eggs and prelarvae in the reproductive tract of the females (*Scheloribates laevigatus*) were determined in temporary preparations in the lactic acid under light microscope.

#### Estimating methods

The abundance values were transformed by  $\log_e(n+1)$ , when  $n$  is abundance in one sample (Jongman et al. 1987) to compare plots. The data were expressed as a means from observations and evaluated by analysis of variance (ANOVA with Tukey test for multiple range analysis, on probability level  $\alpha > 0.05$ ). Possible aggregation tendencies of this species were derived from the diagrams of abundance. The proportion of male / female and gravid female / barren female were tested  $\chi^2$  test, the expected frequencies were 1 / 1 (on probability level  $\alpha > 0.05$ ). The

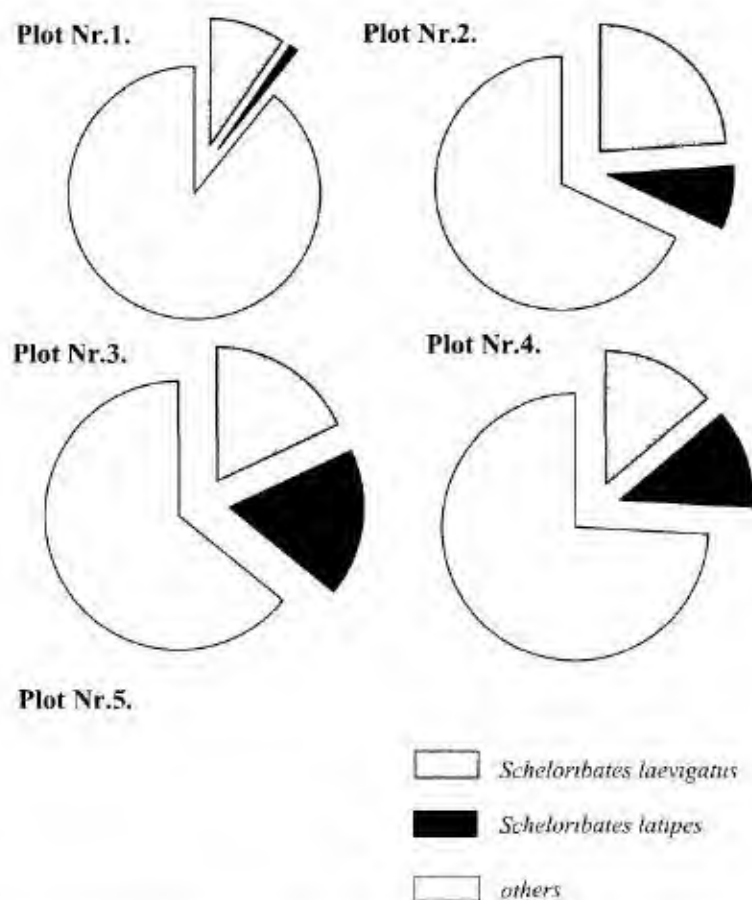


Fig. 1. Comparison of relative abundance (dominance) of *Scheloribates laevigatus* (C. L. Koch) and *Scheloribates latipes* (C. L. Koch) on studied plots.

Tab. 2. Some estimated characteristics of *Scheloribates laevigatus* (C. L. Koch) on studied plots. Eggs per gravid females and eggs per females are means from eggs per gravid female and per female per sample. Numbers of eggs are mean number of eggs observed in females oviducts per sample. Notes: (1) The proportions male / female and gravid (GF) / barren (UGF) females were tested using  $\chi^2$  test, the expected frequencies were 1 / 1 (on probability level  $\alpha > 0.05$ ). (2) Differences among studied plots in numbers of eggs per gravid female and number of eggs per female were tested using Kruskal-Wallis test (on probability level  $\alpha > 0.05$ ). Abbreviation used: \*\*\* – significant difference, ns – no significant difference.

Plot		Nr 1	Nr 2	Nr 3	Nr 4	Nr 5	dif
total abundance		847	1506	1649	902	430	—
proportion of males		0,55	0,55	0,50	0,51	0,57	—
proportion of females		0,45	0,45	0,50	0,49	0,43	—
$\chi^2$ test M/F ( $\alpha > 0.05$ )		0,00	0,00	0,94	0,42	0,01	—
significance		***	***	ns	ns	***	—
prop. of eggs in females	0	0,43	0,38	0,40	0,40	0,34	—
	1–2	0,18	0,22	0,24	0,23	0,16	—
	3–5	0,29	0,31	0,27	0,31	0,37	—
	6–10	0,10	0,10	0,09	0,06	0,13	—
$\chi^2$ test GF/UGF ( $\alpha > 0.05$ )		0,00	0,00	0,00	0,00	0,00	0,00
significance		***	***	***	***	***	***
prop. gravid females		0,57	0,62	0,60	0,60	0,66	—
prop. larvipar. females		0,24	0,21	0,23	0,20	0,22	—
eggs per gravid female		2,01	2,50	2,71	2,20	2,14	***
eggs per female		1,53	1,89	1,97	1,78	1,75	ns
numbers of eggs		6,6	10,8	12,7	7,1	6,1	***

numbers eggs per females and per gravid females were calculated in every sample, the means from samples per plot per month were presented. The differences among studied plots were evaluated using Kruskal-Wallis analysis by ranks (on probability level  $\alpha > 0.05$ ). The numbers of eggs were also calculated in every sample and differences among studied plots were evaluated using Kruskal-Wallis test.

In order to get comparable data, all obtained and published densities were recalculated (and rounded) to 1 m<sup>2</sup>. Oribatids of the families *Brachychthonidae*, *Oppidae*, *Suctobelbidae*, and genus *Phthiracarus* Port, 1841 were not identified at the species level, which applies also to most publish references. Hence, they were included in synecological calculations, incl. species numbers (S) and the number of abundant species (Sa – total abundance > 10 individuals) as one taxon.

## RESULTS

*Scheloribates laevigatus* was dominant species on all studied plots (Fig. 1). *Scheloribates laevigatus* occurred together with related species *Scheloribates latipes* (C. L. Koch, 1844) on all studied plots. Except plot Nr 3, *Scheloribates laevigatus* prevailed on *Scheloribates latipes*. The dominance of these species was similar on plot Nr 5. On the Tehovec meadow, 16 713 oribatid mites from 43 taxa were found. Except *S. laevigatus* on dominant on both plots (dominance > 0.05) were dominant: *Achipteria coleoptrata* (Linnaeus, 1758); *Ceratozetes mediocris* Berlese, 1908 and *Oppidae* on plot Nr 1 and *Ceratozetes mediocris*, *Oppidae* and *Scheloribates latipes* on plot Nr 2. On the Vojkov meadow, 23 489 oribatid mites from 55 taxa were found, except *S. laevigatus* dominant species on plot Nr 3 were: *Ceratozetes mediocris*, *Nanhermannia nanus* (Nicolet, 1855), *Pantolozetes paoli* (Oudemans, 1913) and *S. latipes*. *Ceratozetes gracilis* (Michael, 1884), *Hypochthonius rufulus* C. L. Koch, 1835, *Mimothozetes semirufus* (C. L. Koch, 1841), *Oppidae* and *Trichoribates trimaculatus* (C. L. Koch, 1835) were dominant on plot Nr 4, together with both *Scheloribates*

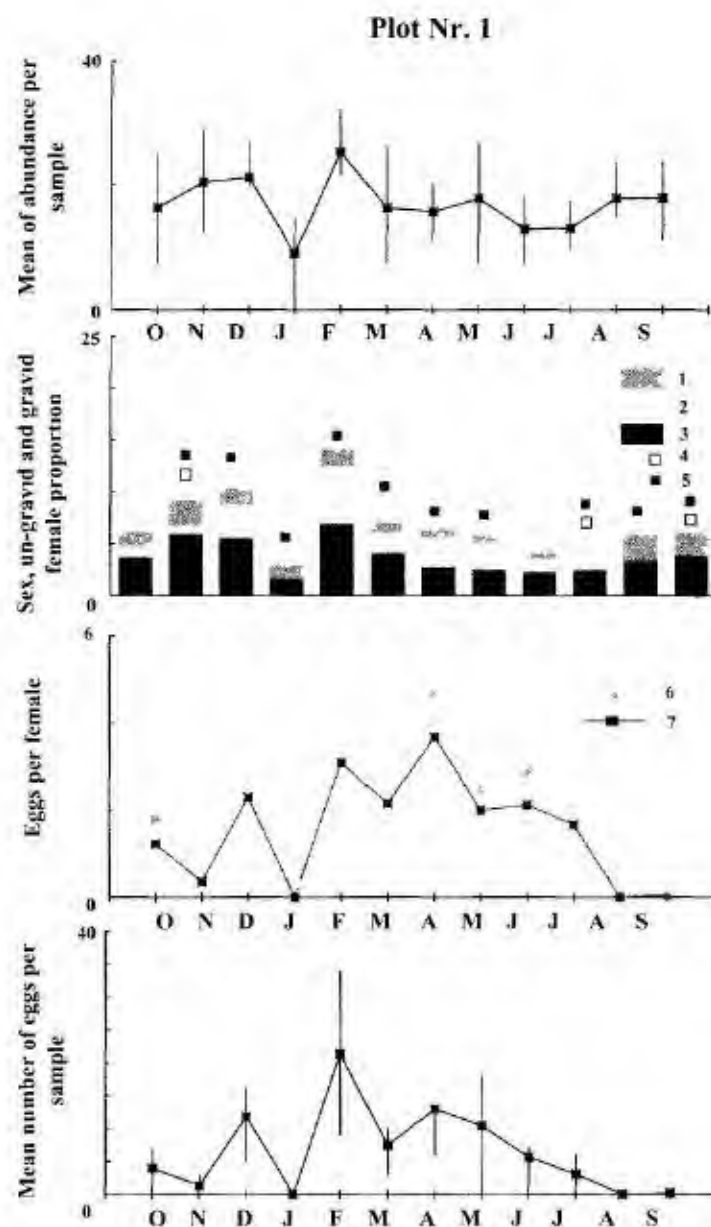


Fig. 2. Ecological characteristics of *Schcloribates laevigatus* (C. L. Koch) on plot Nr. 1. The first figure had log (n+1) scale. The ratios of males / females and gravid females / barren females were tested using  $\chi^2$  test; the expected frequencies were 1 / 1 (on probability level  $\alpha > 0.05$ ). Abbreviation used: abscissa - interquartile range; 1 - barren females; 2 - gravid females; 3 - males; 4 - significant differences from males / females (1 / 1); 5 - significant differences gravid females / barren females (1 / 1); 6 - mean of eggs per gravid female; 7 - mean of eggs per female.

species *Oppidae*, *Oribatula tibialis* (Nicolet, 1855) and *Tectocephus velatus* (Michael, 1880) were dominant together with *Scheloribates laevigatus* on plot Nr 5

#### Plot Nr 1

Population density of *S. laevigatus* was intermediate on this plot (Tab 1), ca 6 individuals per sample (cylindrical 50 mm diameter and 50 mm high). The ratio males / females tended to unity generally, although the males prevailed on females (Tab 2). Ca 60 per cent of females had eggs in their oviducts (gravid). Every gravid female was considered larviparous, in which at least one prelarvae was found. The many females had eggs and prelarvae in their oviducts, simultaneously. The number of larviparous females increased together with increasing number of females in samples ( $y = 0.5x - 1$ ,  $R^2 = 0.82$ ). The mean number of eggs per gravid female was low in comparison to following plots.

The population of *S. laevigatus* fluctuated during season. The peak of individual numbers (13 individuals per sample) was in February, distinct minimum was in January (Fig. 2). The aggregation tendencies are positively correlated with its abundance. Marked space gradients were not observed (Fig. 12). The highest aggregation tendencies were in February together with maximum of abundance. The smaller aggregation tendencies were observed in November and December.

The gravid females were absent in January and in August (Fig. 2), mean number of gravid females had a peak in February (about 6 gravid females per sample). The mean numbers of eggs per female and per gravid female had no differences in their fluctuation. The peaks of eggs numbers per female and per gravid female were in April (about 4 eggs per female and 5 eggs per gravid female), the minima due to absence of gravid females were in January, August and September. The mean number of eggs per sample showed the similar trends as number of eggs per female. The mean of egg number per sample reached maximum (13 eggs) in April.

The changes of mean number of gravid females and frequency of egg numbers in female oviducts (Fig. 7) are indirect marks of oviposition. When the number of gravid females decreased together with decreasing egg numbers per gravid female, the females probably are laying eggs during this time. The increase of the ratio males / females could be in relation to oviposition indicating some of females died after oviposition. The ratios male / female and gravid / barren females tended to one in October. Numbers of females and gravid females decreased strongly from October to November, also the mean of egg number per sample was low in November. These features indicated eggs or larvae deposition (oviposition) in October, when females died after it. The lower intensity of oviposition followed in December and in June and July.

#### Plot Nr 2

The population density of *S. laevigatus* was higher than on the previous plot (Tab 1), with a mean about 10 individuals per sample. The sex ratio and proportion of gravid females were similar to previous plot (Tab 2), while mean number of eggs per female was higher. Number of larviparous females showed similar trend as on plot Nr 1 ( $y = 0.5x - 4$ ,  $R^2 = 0.73$ ).

The population showed similar fluctuation as on the previous plot, although the peak of individuals was in December (ca 18 individuals per sample – see Fig. 3). The highest aggregation tendencies (Fig. 8) were in February, it did not correlate to the peak of abundance. The lower aggregation tendencies were observed in October, November, December, March and September, additionally.

The gravid females occurred during the whole observed period (Fig. 3), mean number of gravid females had maxima in December and February (7 and 6 gravid females per sample, respectively), the minima was in the same month then on plot Nr 1. The gravid females prevailed on barren females approximately in the same month as on plot Nr 1. The mean number of eggs per female and per gravid female showed similar trends as on plot Nr 1, although both differed in maxima. The maxima



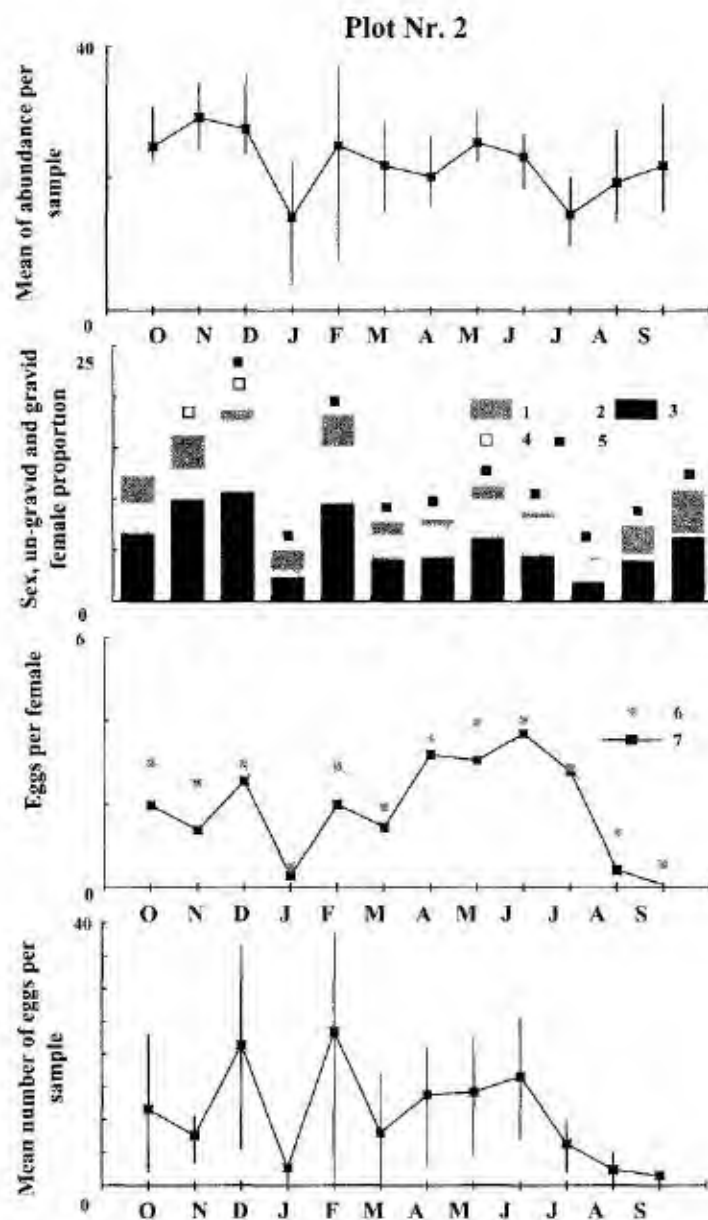


Fig. 3. Ecological characteristics of *Scheloriobates laevigatus* (C. L. Koch) on plot Nr. 2. The first and the fourth figure had logarithmical  $\log_2(n+1)$  scale. The ratios of males / females and gravid females / barren females were tested using  $\chi^2$  test; the expected frequencies were 1 / 1 (on probability level  $\alpha > 0.05$ ). Abbreviation used: abscissa – interquartile range; 1 – barren females; 2 – gravid females; 3 – males; 4 – significant differences from males / females (1 / 1); 5 – significant differences gravid females / barren females (1 / 1); 6 – mean of eggs per gravid female; 7 – mean of eggs per female.

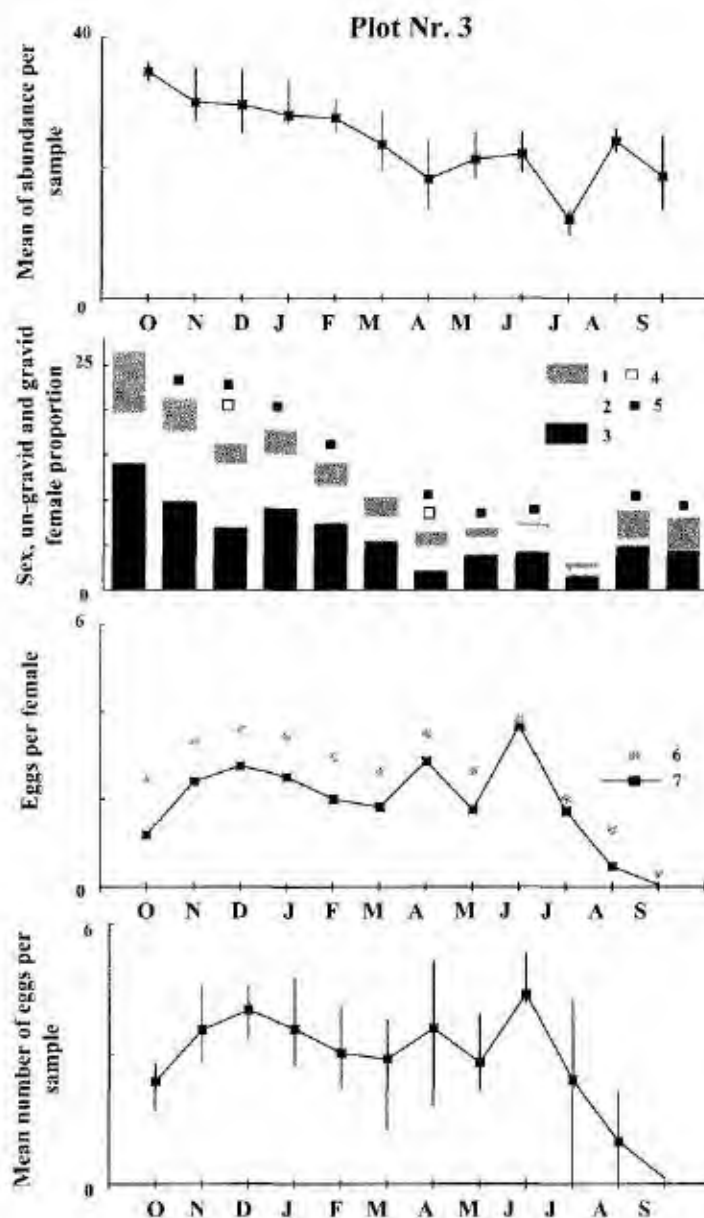


Fig. 4 Ecological characteristics of *Scheloriobates laevigatus* (C. L. Koch) on plot Nr. 3. The first and the forth figure had logarithmical -  $\log(n+1)$  scale. The ratios of males / females and gravid females / barren females were tested using  $\chi^2$  test, the expected frequencies were 1 / 1 (on probability level  $\alpha > 0.05$ ). Abbreviation used: abscissa - interquartile range, 1 - barren females, 2 - gravid females, 3 - males, 4 - significant differences from males / females (1 / 1), 5 - significant differences gravid females / barren females (1 / 1), 6 - mean of eggs per gravid female, 7 - mean of eggs per female.

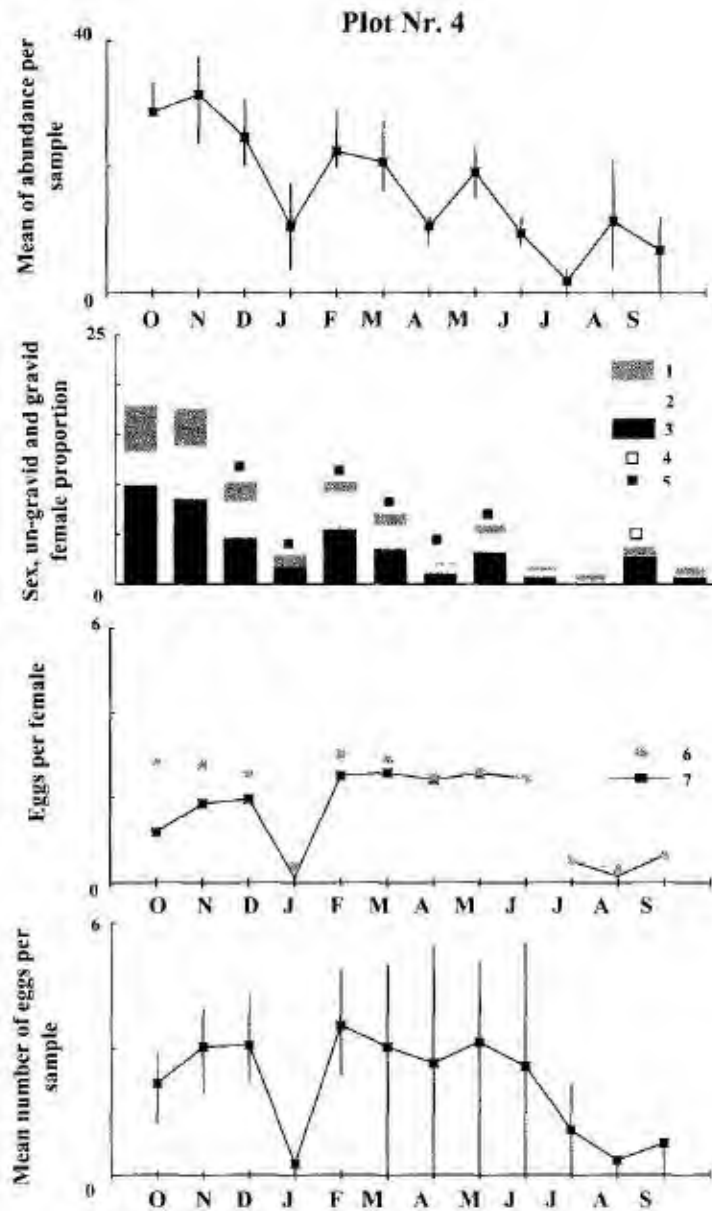


Fig. 5. Ecological characteristics of *Scheloribates laevigatus* (C. L. Koch) on plot Nr. 4. The first and the fourth figure had logarithmical  $\sim \log(n+1)$  scale. The ratios of males / females and gravid females / barren females were tested using  $\chi^2$  test, the expected frequencies were 1 / 1 (on probability level  $\alpha > 0.05$ ). Abbreviation used: abscissa = interquartile range, 1 - barren females, 2 - gravid females, 3 - males, 4 - significant differences from males / females (1 / 1), 5 - significant differences gravid females / barren females (1 / 1), 6 - mean of eggs per gravid female, 7 - mean of eggs per female.

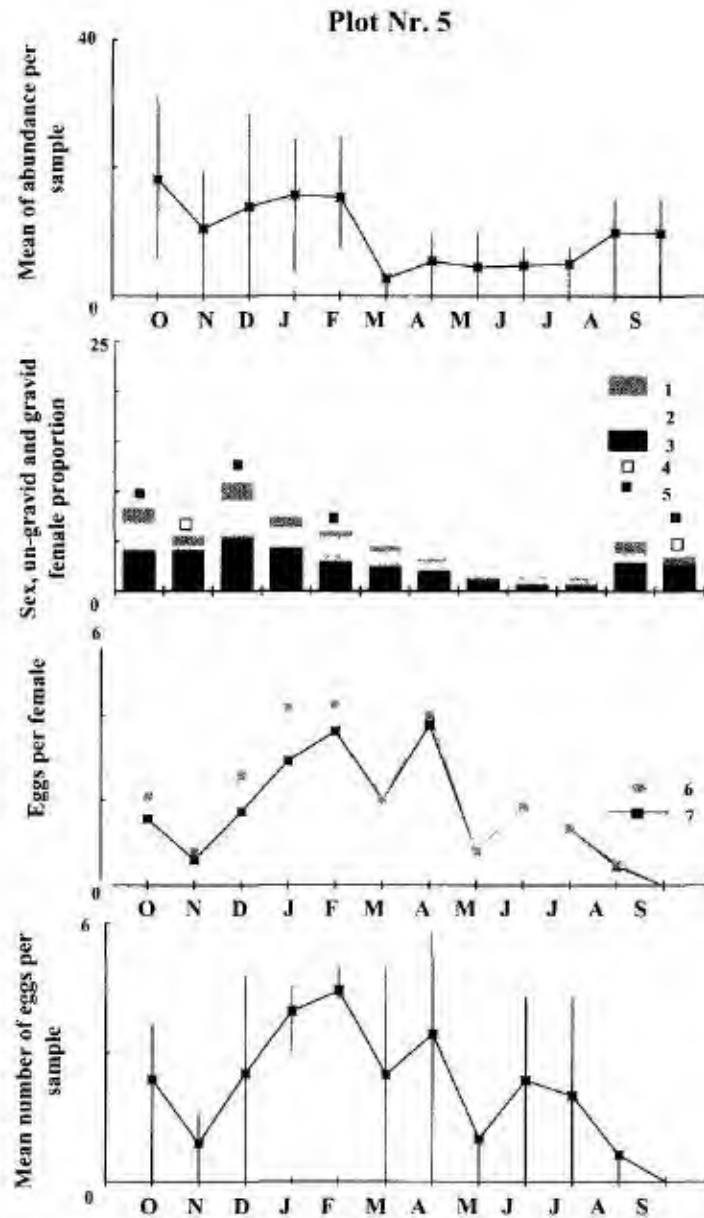


Fig. 6 Ecological characteristics of *Scheloribates laevigatus* (C. L. Koch) on plot Nr. 5. The first and the fourth figure had logarithmical -  $\log(n+1)$  scale. The ratios of males / females and gravid females / barren females were tested using  $\chi^2$  test, the expected frequencies were 1 / 1 (on probability level  $\alpha > 0.05$ ). Abbreviation used: abscissa = interquartile range, 1 - barren females, 2 - gravid females, 3 - males, 4 - significant differences from males / females (1 / 1), 5 - significant differences gravid females / barren females (1 / 1), 6 - mean of eggs per gravid female, 7 - mean of eggs per female.

were in June (4 eggs per gravid and per female). The mean number of eggs per sample showed similar trends as number of eggs per female. There were three minima in January, August and September. The mean number of eggs per sample reached maximum (17 eggs) in June.

The oviposition showed similar trends as on previous plot, started about month later than in autumn and in summer. The changes in the frequency of eggs number in female oviducts (Fig. 8) and the ratio gravid / barren females (Fig. 3) indicate oviposition in November and December. The males prevailed on females, so females probably died after oviposition in these months. The next oviposition took place in July and August, the sex ratio tended to unity during this months (Fig. 3).

#### **Plot Nr 3**

The population density was similar to plot Nr 2 (Tab. 1), with a mean ca 11 individuals per sample. The sex ratio tends to unity (Tab. 2). Proportion of gravid females and was similar to plot Nr 2. The total mean number of eggs per female and per gravid female reached higher values than on others plots (Tab. 2). Number of larviparous females showed similar trend as on plot Nr 2 ( $y = 0.3x + 3$ ,  $R^2 = 0.52$ ), except November. The high number of gravid females (94 females) did not correspond to low number of larviparous females (18 females) in November.

The fluctuations of population density differed from the previous plots, the minimum was in June, not in February. The peak of individuals (25 individuals per sample) was in October (Fig. 4). The highest aggregation tendencies were in October (Fig. 8), aggregation followed from this month to February. Some aggregation was in January, only on this plot.

The gravid females were occurring during the whole observed period, although only 1 gravid female was sampled in September (Fig. 4). The low mean numbers of gravid females was in August, also. The peak of gravid female numbers was in November about (8 gravid females per sample).

The gravid females prevailed on barren females from November to February and from April to June. Except January the mean numbers of eggs per female and per gravid female had no remarkable differences in their fluctuations from plot Nr 2, both numbers reached maximum in June (about 4 eggs per gravid female and per female per sample). The mean of egg number had the same trends, maximum in June (12 eggs per sample), higher values in December and April, low values in August and September.

The changes in the frequency of eggs number in female oviducts (Fig. 7) showed similar trend as on previous plots. The oviposition took place in October and from in July to August. The females prevailed on males in December and in April. It indicating no mortality of females after the main deposition of eggs was observed on this plot, this situation has not been observed on others plots.

#### **Plot Nr 4**

Population density was intermediate (Tab. 1) similar as on plot Nr 1, ca 7 individuals per sample. The sex ratio tends to unity (Tab. 2), similarly as on previous plot. Proportion of gravid and larviparous females had no difference from previous plot. Mean number of eggs per female and per gravid female was lower than on previous plot. Mean number of eggs reached intermediate values. Number of larviparous females showed similar trend as on previous plot ( $y = 0.3x + 1$ ,  $R^2 = 0.51$ ). Similarly, low number of larviparous females (2 individuals) did not correspond to high number of gravid females (52 individuals) in November.

The seasonal changes in population were not similar to previous plots (Fig. 5). The mean of abundance reached maximum in November (22 individuals per sample), minimum was in June. The highest number of individuals was found in one sample in November in comparison of all samples obtained on the studied meadows (58 individuals). The aggregation tendencies were the highest in November (Fig. 8), occurred during October, December and February, also.

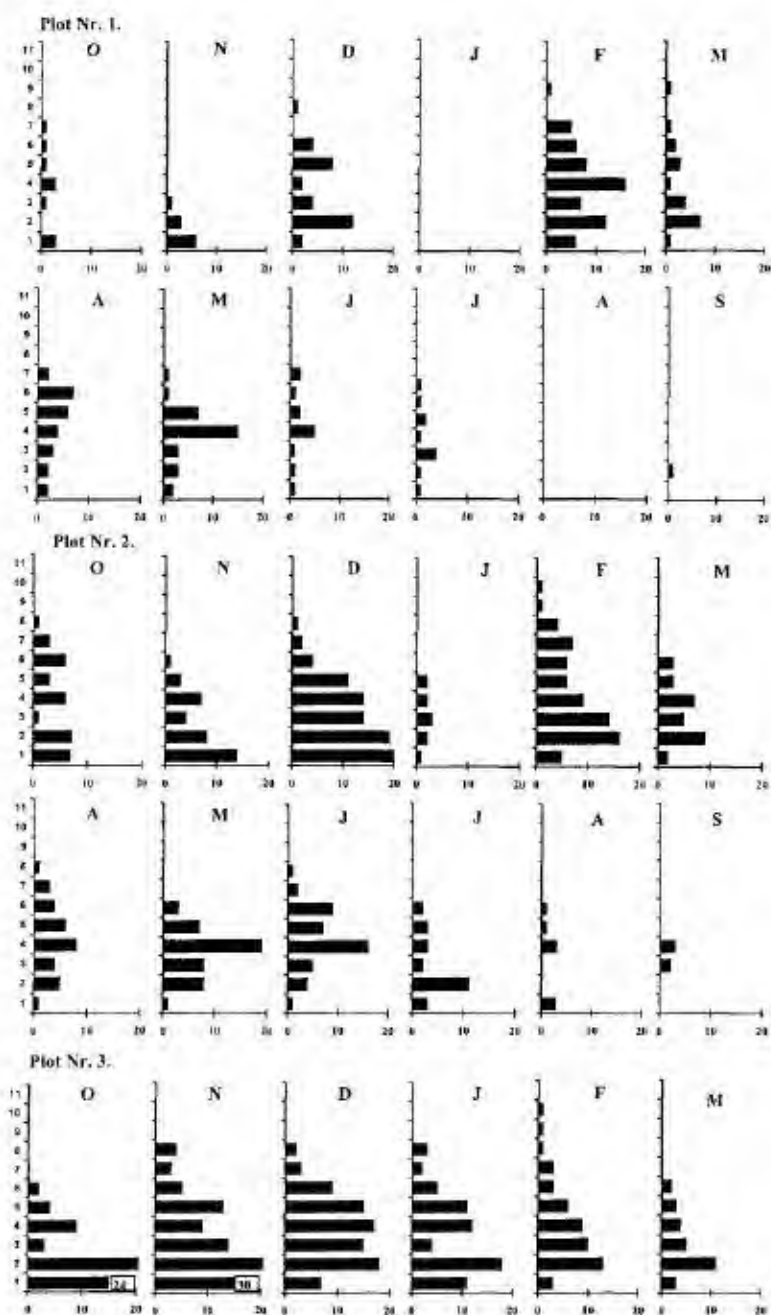


Fig. 7. Seasonal changes in egg frequencies in *Scheloribates laevigatus* (C. L. Koch) female oviducts on studied plots.



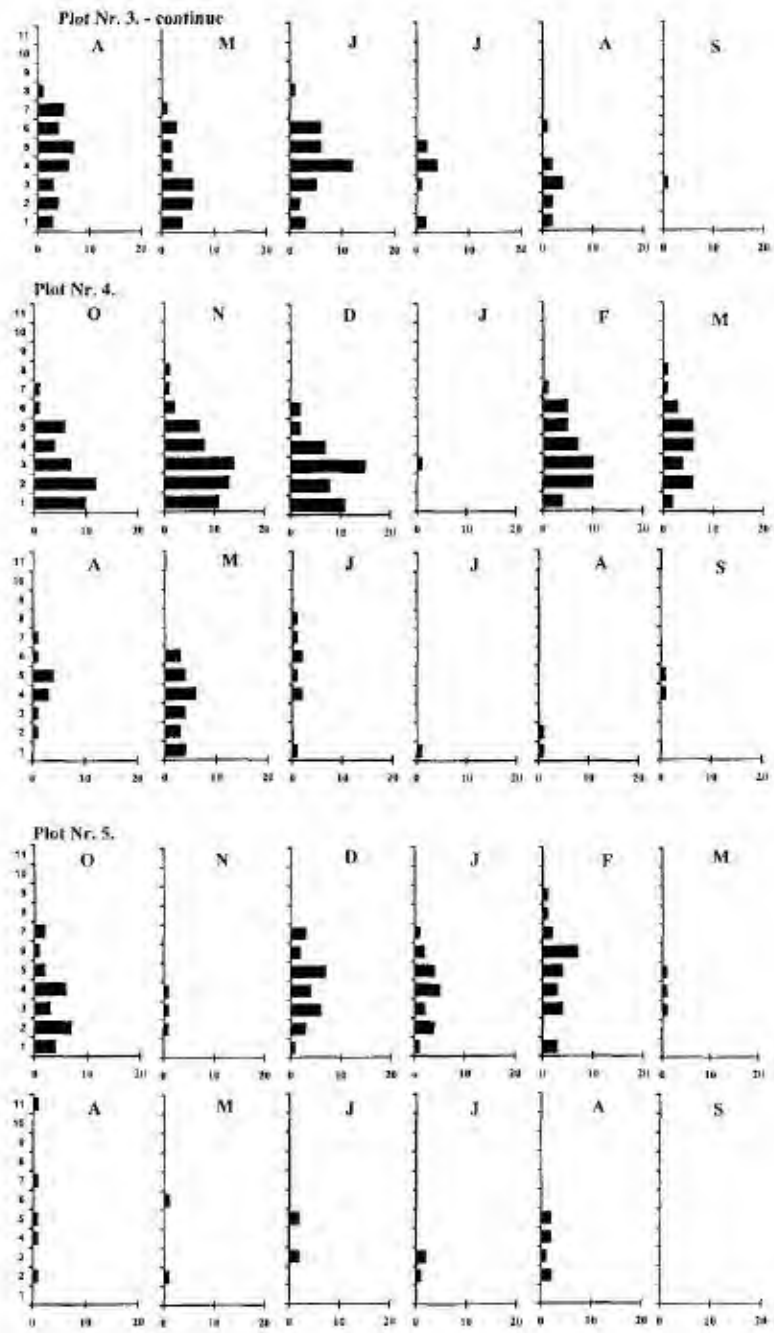


Fig. 7 (continued)

The number of gravid females had maximum in November (about 5 gravid females per sample) and minima in January and from July to August. The gravid female prevailed on barren females in December and from February to March (Fig. 5). The mean of eggs per female and mean of eggs per gravid female had minima in January and from July to September, its fluctuation was small during the other months. In February, mean of eggs per gravid female and per female was ca 3 eggs. The mean number of eggs showed the similar trend as in plot Nr 2, with minimum in January and low values from July to September. The small maximum was in February (about 13 eggs per sample).

The changes of mean number of gravid females and frequency of egg number in female oviducts (Fig. 7) indicate oviposition in December and in June, similarly as on previous plots. The males prevailed on females in August. The relation to oviposition is hard to evaluate, because only 2 individuals were found in July.

#### Plot Nr 5

The population density was low (Tab. 1) in comparison to previous plots, ca 3 individuals per sample (100 cm<sup>3</sup>). The males prevailed on females (Tab. 2), similarly as on plots Nr 1, 2. The proportion of gravid females was higher than on other plots. Mean number of eggs per female and per gravid female reached intermediate values, while mean number of eggs per sample had minimum from studied plots. Number of larviparous females showed similar trend as on plots Nr 1 and 2 ( $y = 0.4x - 0.2$ ;  $R^2 = 0.87$ ).

The seasonal fluctuation of population differed from previous plot. The mean number of abundance reached a maximum in October (9 individuals per sample), similarly as on plot Nr 3. Minimum was in March and low population density followed to August (Fig. 6). The aggregation trends differed from previous plots. They showed an environmental gradient between forest edge and meadow. *S. laevigatus* was found more frequently in samples taken at a greater distance from the forest edge. Here, the species was aggregated in October and December (Fig. 8).

The gravid females were absent in September, mean number of gravid females reached maximum in December (4 gravid females per sample) and decreased from this month to July (Fig. 6). The gravid females prevailed on females without eggs in October, in December and in February. The mean numbers of eggs per female and per gravid female differed from previous plots, the maxima were in January and February (about 3 eggs per female and 4 eggs per gravid female per sample). The mean number of eggs showed the similar trends as number of eggs per female. The maximum 12 eggs per sample was in February, minima were in August and September.

The time of oviposition was probably similar as on previous plots. The mean number of gravid females and frequency of eggs number in female oviducts (Fig. 7) indicated oviposition in October and from July to August. The males prevailed on females in November and in September, so females probably died after oviposition.

### DISCUSSION

*Scheloribates laevigatus* is common on meadows, on the other habitats is low abundant (Tab. 3). The data obtained during the study of oribatid communities on two meadows near Říčany support these results. High relative abundance (dominance) of *S. laevigatus* is characteristic for the oribatid community on meadow habitats, while the occurrence of other dominant and frequent species on studied meadows differed from plot to plot. Unlike the authors listed in the Tab. 3, *S. laevigatus* is often syntopic with *S. latipes* on the Tehovec and Vojkov meadows.

The main population peaks of oribatid adults are in soil of the woodlands higher in December and lower in February or in March, population densities of adults are generally low during summer (Luxton 1981a). Differently, some mite populations in grasslands had the population peak in the

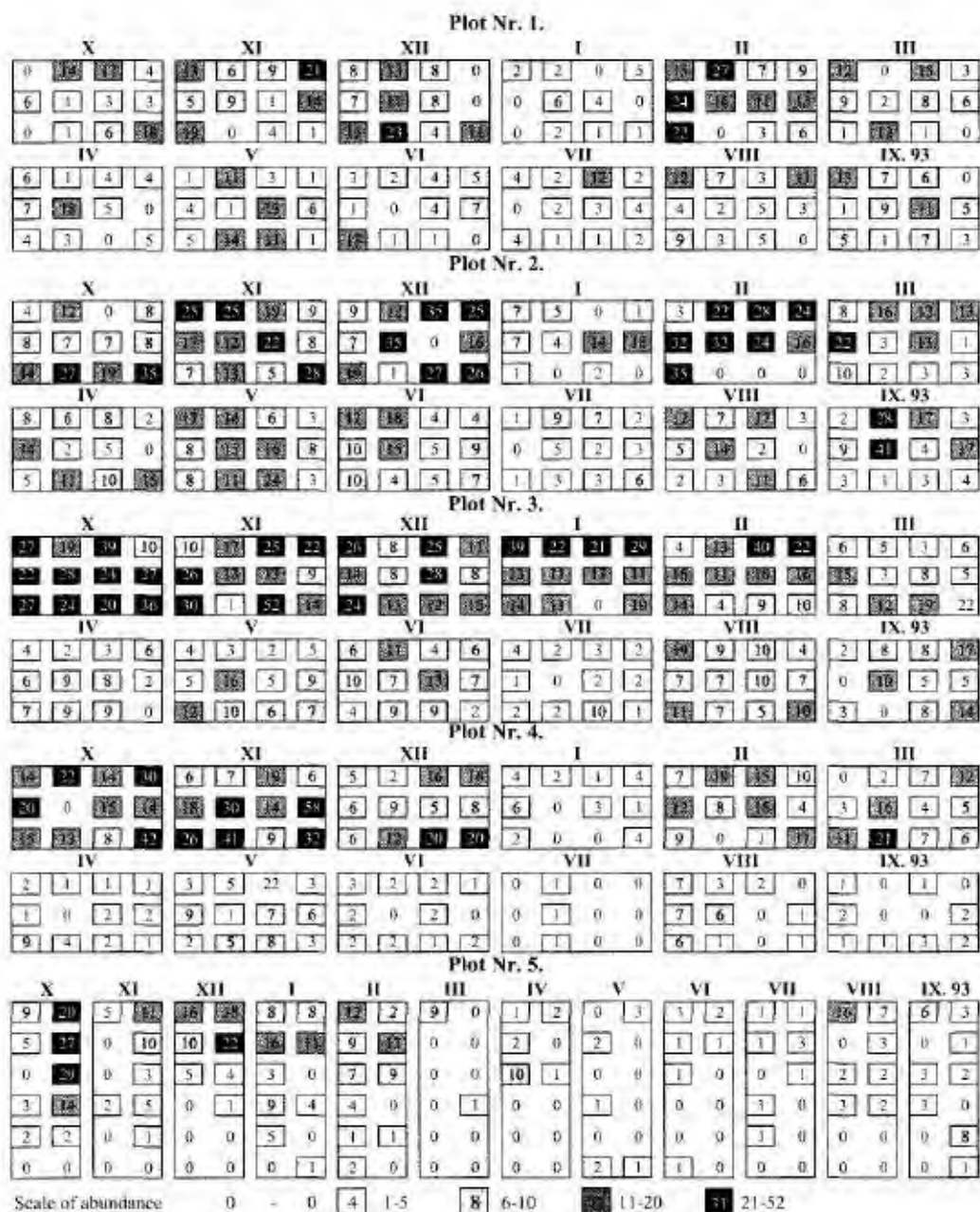


Fig. 8. Seasonal changes of abundance and aggregations of *Scheloriabates laevigatus* (C. L. Koch) in the studied plots.

Tab. 3. Comparison of oribatid communities from different habitats. Abbreviation used: N – estimate of density [individuals per m<sup>2</sup>], S – number of species, Sa – number of species with densities higher than 10 individuals per m<sup>2</sup>, Sch-lae – *Scheloribates laevigatus* (C. L. Koch), Sch-lat – *Scheloribates latipes* (C. L. Koch)

biotope	Sch-lae	Sch-lat	N	S	Sa	references
forest	40	0	32900	60	25	Starý 1990
	20	0	23800	37	17	Hajmová 1997
	0	0	9700	23	14	Zelenková 1986
	0	0	3600	19	14	Tříšková 1991
	60	20	31800	37	23	Seibert 1993
	0	0	4900	26	17	Zelenková 1986
	0	0	6800	42	29	Černý 1991
	0	0	5700	32	20	Černý 1991
	0	0	10300	46	33	Černý 1991
	90	10	24700	79	31	El-Shereef 1988
	0	0	1900	24	13	Tříšková 1991
	10	0	20400	62	20	Starý 1990
	50	0	49800	57	27	Starý 1990
	0	0	2700	20	6	Hojhalová 1989
	150	0	3800	22	16	Skaláková 1986
	400	120	24000	38	22	Seibert 1993
	10	0	8100	24	15	Zelenková 1986
	0	0	8700	33	22	Černý 1991
	10	0	8800	20	13	Skaláková 1986
	0	0	4100	23	16	Tříšková 1991
grassland anthropogenous stands	0	0	1500	23	7	Hojhalová 1989
	0	0	1100	16	6	Hojhalová 1989
	300	0	8900	22	13	Skaláková 1986
	20	10	2800	14	4	Hubert 1996
	180	30	2200	24	9	Hubert 1996
	10	10	7300	28	17	Hubert 1996
	10	10	1400	13	2	Hubert 1996
meadow	3820	220	9900	34	14	Starý 1990
	1080	0	25200	51	20	Starý 1990
	10	30	3100	29	8	Seibert 1993
	300	10	4500	25	11	Vlčková 1993
	710	10	5900	27	13	Vlčková 1993
	490	0	11700	23	20	Mazancová 1989
	270	0	4500	21	14	Mazancová 1989
	170	40	30300	82	47	El-Shereef 1988
	2390	240	24600	38	23	plot Nr 1
	4380	1430	18300	37	21	plot Nr 2
	2940	2490	21100	39	25	plot Nr 3
	4460	4430	24800	40	29	plot Nr 4
	1300	50	14300	50	25	plot Nr 5
	1870	30	26600	30	9	Hubert 1996
	70	0	1500	28	12	Hajmová 1997
pasture	420	10	6700	25	15	Vlčková 1993
	650	10	8700	30	19	Bičanová 1997
	50	10	700	23	10	Bičanová 1997
	50	0	3400	15	9	Bičanová 1997
	10	10	700	15	3	Hubert 1996
steppe	500	0	13300	51	28	El-Shereef 1988
	20	0	12800	30	18	Hajmová 1997

summer months in relation to high herbage biomass (Whelan 1985). The populations of *S. laevigatus* showed different fluctuation, which varied from plot to plot. Plots Nr 1 and 2 showed some similar trends in abundance fluctuation however plots Nr 3 – 5 differed. The precipitation, together with litter input are suggested as the most important factors controlled phenological patterns of oribatid mites (Luxton 1981c). All studied plots were influenced by these factors similarly. The distance between the two study meadows was ca. 500 m, so that their climate, particularly precipitation and temperature, was apparently the same. Hence, all studied populations of *S. laevigatus* seemed to be influenced by the rather similar amount of litter, and by the same macroclimatic factors, which contrasts with fluctuations of their densities observed and as not sufficiently explained yet. Nevertheless, the two meadows could differ in their microclimate and are differed in herbs composition. The plants are influencing the microclimate (Wallwork 1976). The direct or indirect effect of vegetation is availability of food sources for oribatids (Luxton 1972, Whelan 1985). Černova & Čuganova (1967) observed that oribatid communities on a meadow changed in relation to the structure and taxonomic composition of the vegetation communities. Schenker (1986) explained the large seasonal fluctuation of oribatid mites due to high mortality in relation to high reproduction rate.

The aggregation tendencies are related to the gradients of food supply, and various properties of the soil (Mitchell 1978). The seasonal changes of oribatids population, changes depth distribution of oribatids or with patterns of egg laying are influencing aggregation of oribatids, also (Luxton 1981a). Aggregations were observed even in such homogenous habitat as fields (Smrž & Jungová 1987). Aggregation patterns were no found in *S. laevigatus* in any relation to reproduction, but the aggregation occurred on food, especially on green bark algae *Protococcus viridis* (syn. *Desmococcus vulgaris*) (see Hubert et. al 1998) under laboratory conditions. Hence, patchy distribution of food sources for *S. laevigatus* can be assumed, resulting in aggregations of this species.

According to Luxton (1981b), *S. laevigatus* could be categorised into species where the ratios of males and females tended to unity. Although females of *S. laevigatus* can mature more than one batch (Woodring & Cook 1962), the fluctuation in males females ratio indicating some *S. laevigatus* females died after autumn oviposition.



Fig. 9. Larviparous female of *Schelorbates laevigatus* (C. L. Koch)

The males deposit stalked spermatophores which are subsequently picked up by the females (Woodring & Cook 1962). A single female may lay a very large number of eggs during her reproductively active lifetime (Luxton 1981b). The eggs were found in females of *S. laevigatus* during all season, also males *S. laevigatus* had spermatozoa in vesicula seminalis during the whole year (Hubert & Smrř 1998). The deposition of spermatophores by males and picking by females could take place during all season.

In woodland, many species are laying eggs during the summer and early autumn, these eggs hatched on following autumnal peak of precipitation (Webb & Elmes 1979, Luxton 1981b). Similarly, *S. laevigatus* had the major deposition of eggs in later autumn, on observed meadows. The hatching could follow after deposition immediately due to observed larvipary. The initiation of egg maturation coincides with decreasing soil moisture and increasing temperature (Mitchell 1977). Lebrun (1970) observed high proportion of gravid females *Nothrus palustris* C. L. Koch, 1839 throughout the year, females failed to deposit eggs until soil temperature increased. Smrř (1994) observed mass oviposition as a response to water immersion on *Scutovertex minutus* (C. L. Koch, 1836). The occurrence of matured eggs and spermatozoa on *S. minutus* during the whole year indicated operative oviposition triggered by suitable conditions (Smrř 1994). The egg and prelarva content of females of *Steganacarus magnus* (Nicolet, 1855) varied in different soil and vegetation types (Webb & Elmes 1979). Mitchell & Parkinson (1976) stated that egg maturation and larval development coincided with high microbial food reserves in the soil. Under laboratory conditions, females of *S. laevigatus* putted more eggs on suitable diet – green bark algae (*Protococcus viridis*) (see Hubert et al 1998).

Woodring & Cook (1962) observed females of *Scheloribates laevigatus* deposit their eggs in the tissue of decaying grass, or apparently into anything soft. These eggs are inserted very deeply. The maximum of eggs found in observed female oviducts was 11 in studied meadows. Observed maximum is similar to Woodring & Cook (1962) observation of females oviposition under laboratory conditions, they observed 12 eggs deposited at one time, the mean was 8. The maximum and mean of eggs are higher under laboratory conditions than ones observed in studied outdoors population.

Eggs found in females oviducts provide an indication of the potential for reproductive productivity, but it is not known how many of these eggs are resorbed before oviposition (Luxton 1981b). Although eggs resorption was not observed on *S. laevigatus* females (see Hubert & Smrř 1998).

There is little information about biology of *S. laevigatus* juveniles. The juveniles are burrowers, and will not survive if prevented from burrowing, they work in small groups and undermine patches of punky debris, rather making long, thin tunnels (Woodring & Cook 1962). The juveniles successfully survived in small boxes on green algae *Protococcus viridis*, also (Hubert et al 1998). Although the laboratory conditions differs from the nature, the burrowing (after Woodring & Cook 1962) probably will be life strategy in the nature conditions. This strategy makes some problems with extraction of juveniles in Berlese-Tullgren funnels.

The larvipary was observed in many oribatid species (Wallwork 1967, Luxton 1981b). On *Steganacarus magnus* egg and prelarva component showed variation between different vegetation types (Webb & Elmes 1979). There is no clear whether egg prelarva complement reflects nutrition or whether it is adaptation to different soil and litter types (Webb 1989). *Scheloribates laevigatus* showed only correlation of increasing number of larviparous females together to increasing number of females on observed meadows, except in November on plots Nr 3 and 4. Larvipary of *S. laevigatus* might be some adaptation to choosing good condition for juveniles by females and shorten development period.

Adult are surface dwellers and feeders, the longevity of adults is ca 120 days at 25 °C (Woodring & Cook 1962). The life cycle from egg to adult takes from 45 to 115 days at the temperature ca 25 °C.



(Cleat 1952), or ca. 64 days (Woodring & Cook, 1962) under laboratory investigations *S. laevigatus* belong to species shown intermediate duration of life cycle (Luxon 1981b). Although the effect of temperature on development period of oribatid mites is studied by many authors (see Lebrun 1970, Webb 1977, Luxton 1981b), it is hard to estimate the duration of the life cycle *S. laevigatus* in nature conditions in changing gradient of temperature and moisture. Woodring & Cook (1962) suggested, more than one generation is initiated in a year (for *S. laevigatus* 3 generation), the population may overwinter. The observed population of *S. laevigatus* showed similar features. The major oviposition of *S. laevigatus* took place in later autumn, although oviposition is possible during all season.

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**First reports of *Liacheles nigripes* from Indonesia and Malaysia and  
*Hormiops davidovi* from Malaysia (Scorpiones: Ischnuridae)**

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**Abstract.** *Liacheles nigripes* (Pocock, 1897) is compared to all other species of the genus *Liacheles* Sundevall, 1833 and first record for Indonesia and Malaysia is established. Key to species of the genus *Liacheles* is provided. First record of *Hormiops davidovi* Fage, 1933 for Malaysia is established.

**Taxonomy, key, faunistics, Scorpiones, Ischnuridae, *Liacheles nigripes*, *Hormiops davidovi*, Oriental region**

***Hormiops davidovi* Fage, 1933  
(Figs 1–7, Tab. 1)**

*Hormiops davidovi* Fage, 1933: 32; Fage, 1936: 181; Fage, 1944: 71; Takashima, 1945: 94; Vachon, 1974: 918; Lourenço & Monod, 1999: 343.

**TYPE LOCALITY.** Poulo-Condore, dans la forêt, sous les pierres.

**MATERIAL EXAMINED.** W. Malaysia, Pahang [state], Tioman Island, W. slope of Mt. Kajang, 23.–25.II.1988, (cg. S. Bočvář & V. Tichý, 2 males, 2 females, and 1 juv. The specimens are dry mounted and are currently in the author's collection.

**REDESCRIPTION.** The total length is 28–38 mm. The habitus is shown in Fig. 1. Measurements of the carapace, telson, segments of the metasoma and of the pedipalps, and numbers of pectinal teeth are given in Table 1. There are 5–7 pectinal teeth. For the position and distribution of trichobothria on the patella and chela (tibia) of pedipalps see Figs 3–7.

The color is uniformly brown, only the telson is yellowish brown.

The carapace lacks keels but is sparsely granulated and bears a straight median longitudinal groove. The large median eyes are situated on a slight elevation, and the two pairs of lateral eyes are placed very close to the anterior margin.

The pedipalps lack dorsal and ventral keels, are densely covered by minute granules of nearly equal size, and are punctate. All segments of the pedipalps, and especially the chela, are longer in the male than in the female (see Figs 1 and 2).

The dorsal surface of the mesosoma lacks keels but is tuberculate. In the anterior part of each mesosomal segment is an irregularly delimited but bilaterally symmetrical, slightly elevated area that encompasses the entire width of the segment (Fig. 1). The seventh segment of the mesosoma ventrally bears two furrows.

The legs are lighter in color than the body, only the external surface of the femur and patella are black and bear keels composed of granules.

The metasoma is very thin, sparsely setose, and its segments have rounded, smooth dorsolateral edges instead of keels. Only the third and fourth segments bear two symmetrical, pointed thorns on

Tab. 1. Measurements in millimeters of *Hormiops davidovi* Fage and *Liacheles nigripes* (Pocock). Line denoted "pectinal teeth" contains numbers of both left and right teeth separated by a colon.

	<i>Hormiops davidovi</i> male	<i>Hormiops davidovi</i> female	<i>Liacheles nigripes</i> male	<i>Liacheles nigripes</i> female
Total length	29.3	29.1	49.1	38
Carapace length	4.0	3.9	7.4	6.3
width	3.8	4.0	7.7	6.9
Metasoma length	11.9	10.7	21.0	15.4
segment I length	1.4	1.4	2.4	1.8
width	0.9	1.0	1.8	1.5
segment II length	2.0	1.8	2.8	2.3
width	0.7	0.8	1.5	1.2
segment III length	1.9	1.5	3.0	2.3
width	0.7	0.8	1.5	1.2
segment IV length	2.3	2.0	3.5	2.7
width	0.7	0.8	1.4	1.2
segment V length	2.3	2.0	4.3	3.0
width	0.6	0.8	1.4	1.2
tailson length	1.9	1.8	4.6	3.2
Pedipalp				
tenuis length	5.8	4.3	7.6	7.6
width	1.5	1.6	3.1	3.1
patella length	5.2	4.2	7.9	7.9
width	1.9	2.1	3.7	3.7
tibia length	9.5	8.1	15.6	15.6
manus width	2.2	2.8	5.4	5.4
movable finger length	3.5	3.3	6.5	6.5
Pectinal teeth	6.6	5.5	9.8	9.8

the posterodorsal surface. The ventral surface of chiefly the second and fifth segments is tuberculate, with keels and pronounced, pointed thorns. The subaculear tooth is smooth and very sparsely setose.

COMMENTS. Fage based *Hormiops davidovi* on three specimens (one male and two females) collected by M. C. Dawydoff during II 1930 – IV 1932 on Poulo-Condore Island (south Vietnam) and deposited in the Muséum National d'Histoire Naturelle, Paris, France. No other occurrence has so far been reported (Fage, 1933: 32, Lourenco & Monod, 1999: 343), and the discovery of this species on Tioman Island can thus be deemed significant.

#### *Liacheles nigripes* (Pocock, 1897)

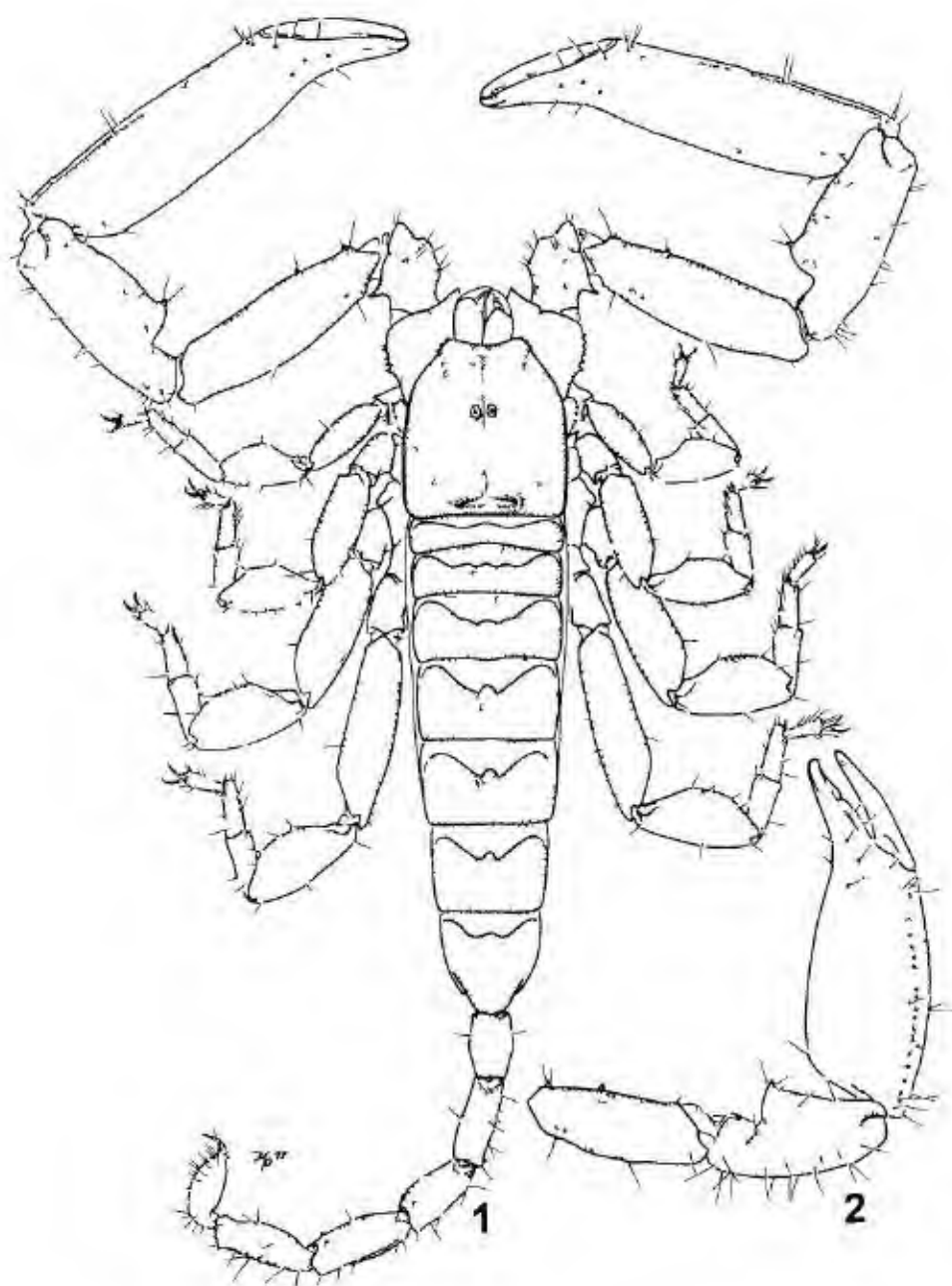
(Figs 8–12, and 14, Table 1)

*Hormurus nigripes* Pocock, 1897: 117, Kraepelin, 1899: 155, Pocock, 1900: 80, Kraepelin, 1913: 163, Giltay, 1931: 10, Fage, 1933: 27, Caus, 1942: 112, Fage, 1944: 72, Minnocci, 1974: 37, Tikader & Bastawade, 1983: 506.

*Hormurus nigripes* [sic] Tikader, 1987: 35.

*Liacheles nigripes* Takashima, 1945: 95, Kovařík, 1995: 202, Kovařík, 1998: 134.

TYPE LOCALITY. India, Panch Mahals in Guzerat.



Figs. 1-2 *Hormiops davidovi*. Fig. 1 - dorsal aspect of male; 2 - pedipalp of female.

TYPE MATERIAL EXAMINED: India: Panch Mahals in Guzerat: 1 female (immature) (holotype) leg. W. A. Wallinger. (Holotype is in the British Museum (Natural History) London, England.)  
ADDITIONAL MATERIAL EXAMINED: Indonesia: West Sumatra south hills above Padangpanjang: 2–6 IV 1996 leg. S. Beevri: 1 female (probably immature). W. Malaysia: Cameron Highland Tanah Rata: 20–24 II 1988 leg. O. Buzga & A. Kudrna: 2 males, 1 juv. All specimens are in the author's collection.

**REDESCRIPTION.** The total length is 38–49.1 mm. Holotype (immature female) is 36 mm long. The habitus is shown in Fig. 14. Measurements of the carapace, telson, segments of the metasoma and of the pedipalps, and numbers of pectinal teeth are given in Table 1. There are 8–9 (3×8, 1×9) pectinal teeth in the males and 6 in the females. For the position and distribution of trichobothria on the patella and chela of pedipalps see Figs 8–12. Position of trichobothrium em2 on the external surface of the patella is variable. Trichobothria Et2–5 on the external surface of the chela are arranged in a straight row in the female, their position in the male is shown in Fig. 11.

A color photo of the still-alive male is in Kovařík (1998: 72).

The color is uniformly black to blackish brown, only the telson is yellowish brown and the legs and chelicerae are brown. The carapace, mesosomal tergites, and dorsal surface of the legs may be slightly speckled.

The carapace lacks keels but is densely punctated and bears a straight median longitudinal groove. The large median eyes are situated on a slight elevation, and the three pairs of lateral eyes are placed very close to the anterior margin.

The pedipalps lack dorsal and ventral keels, are densely covered by minute granules of nearly equal size, and are punctate. In contrast to the female, in males the fingers of the chela are conspicuously flexed (Fig. 11).

The dorsal surface of the mesosoma lacks keels but is tuberculate. In the anterior part of each mesosomal segment is an irregularly delimited but bilaterally symmetrical, slightly elevated area that encompasses the entire width of the segment (Fig. 14). The seventh segment of the mesosoma is ventrally punctate, without keels or furrows.

The metasomal segments are sparsely setose and finely punctate, with smooth and rounded dorsal and lateral margins rather than keels. Only the third and fourth segments bear two symmetrical, pointed thorns on the posterodorsal surface. The ventral surface of chiefly the second and less so of the fifth segments is tuberculate, with keels and pronounced, pointed thorns. The subaculear tooth is smooth and very sparsely setose.

**AFFINITIES.** The described features distinguish *Liocheles nigripes* from all other species of the genus *Liocheles*. They are recounted in the key below.

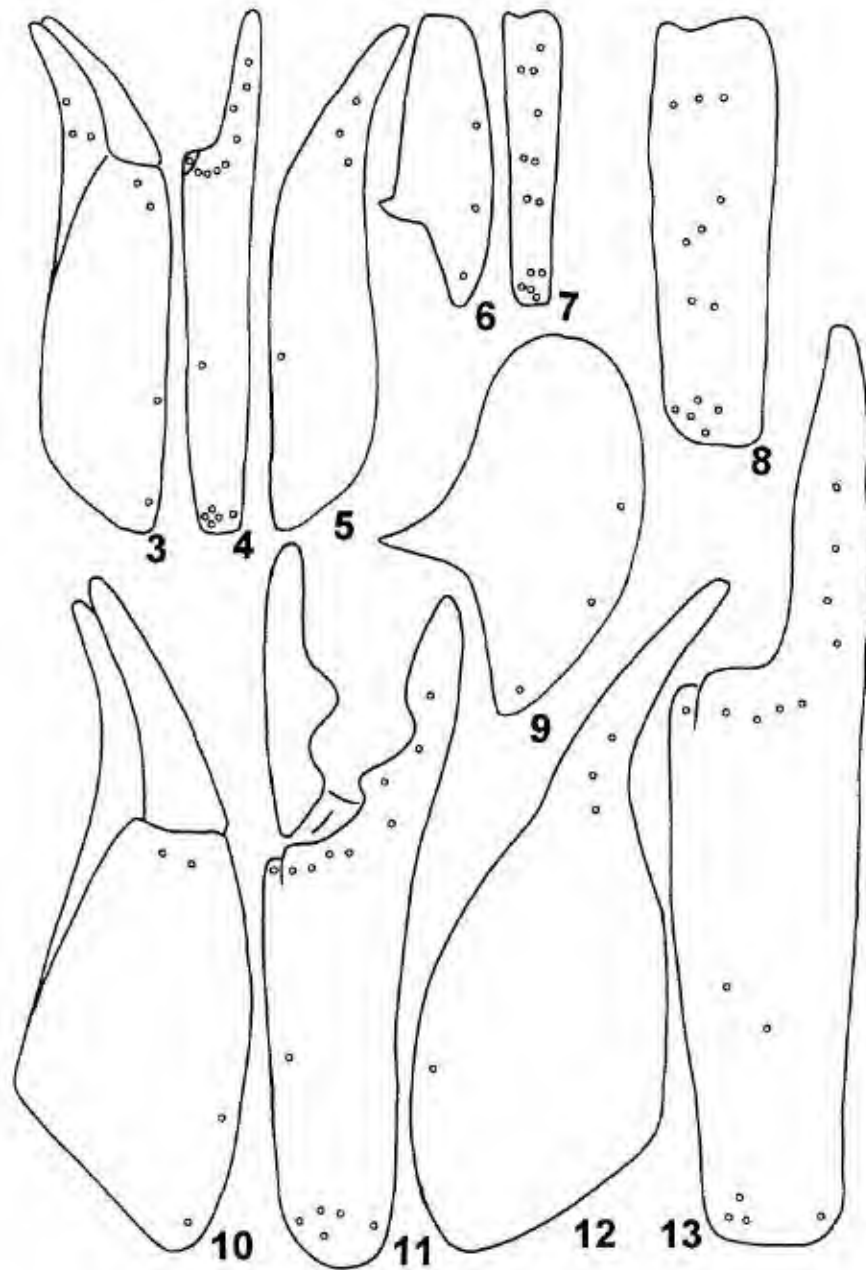
*Liocheles nigripes* is most closely related to *L. waigiensis* and *L. karschi*, which however reach larger size and are easily recognized by the position of trichobothria on the external surface of tibia of pedipalps (Figs 11 and 13).

**COMMENTS.** Sundewall (1833) described the genus *Liocheles* as a subgenus with the type species *Scorpio australasiae* Fabricius, 1775. C. L. Koch (1837) described the genus *Ischnurus* with the type species *Sisyphus* [lapsus calami] (= *Ischnurus*) *complanatus* C. L. Koch, 1837 (= *Liocheles australasiae* Fabricius, 1775). Even recent publications often incorrectly use the generic name *Hormurus* erected by Thorell (1876) with the type species *Ischnurus caudicula* L. Koch, 1867 (= *Liocheles waigiensis* (Gervais, 1844)).

The genus *Liocheles* occurs from India to Australia. The northern limit of distribution is south China and Korea (Kovařík 1998: 1334–134). The type species *L. australasiae* is present throughout the geographic range of the genus and in most locales is the most commonly encountered scorpion species.

*Liocheles nigripes* is based on an immature female from India (Pocock 1897: 117). Fage (1944: 72) recorded this species from Laos and Vietnam, for which reason its occurrence is predicted also in





Figs 3-13. 3-7 - *Hormiops davidovi* Fage, male. 8-12 - *Liacheles nigripes* (Pozock), male from Malaysia. 13 - *Liacheles waigiensis* (Gervais), female. 3, 10 - chela, ventral view. 11 - chela, external view. 4, 13 - tibia, external view. 5, 12 - tibia, dorsal view. 6, 9 - patella, ventral view. 7-8 - patella, external view.

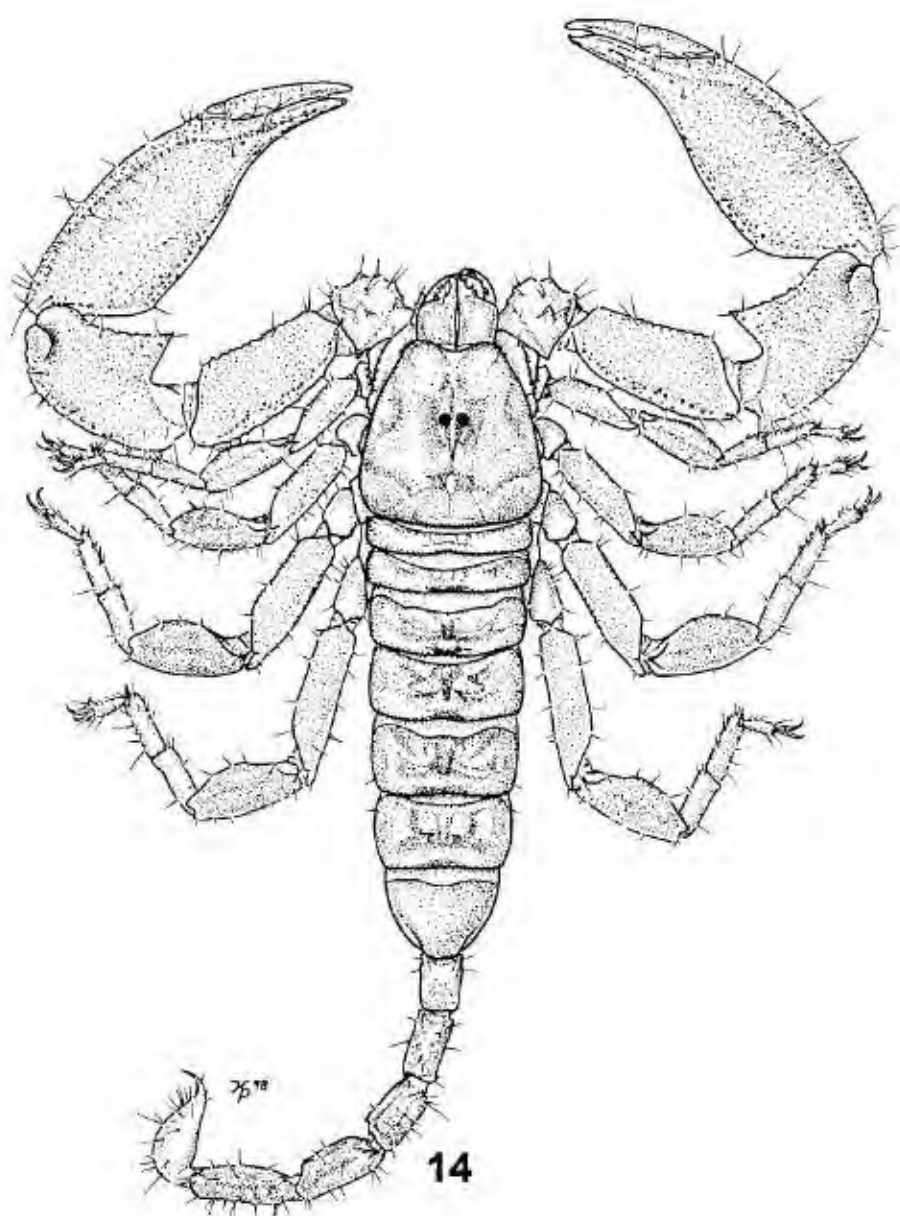


Fig. 14. *Liocheles nigripes* (Pocock). Dorsal aspect of male from Malaysia.

Myanmar, Cambodia, and Thailand (Kovářík 1995–202). The large area of its distribution is evidenced by the record in Indonesia and Malaysia

### Key to *Liocheles* species

- 1 Patella of pedipalps with 5 ventral trichobothria (fig. 8 in Francke & Lourenço, 1991–202) *L. penta* Francke & Lourenço, 1991
- Patella of pedipalps with 3 ventral trichobothria (Fig. 9) 2
- 2 Chela of pedipalps with 5 Eb and Esb trichobothria (Fig. 11) (terminology of trichobothria after Vachon, 1974) 5
- Chela of pedipalps with 4 Eb and Esb trichobothria. Fifth trichobothrium is displaced toward the middle, like Est trichobothria (Fig. 13) 3
- 3 Manus of male very narrow and long. Chela length to width ratio higher than 4.8 *L. longimanus* Locket, 1995
- Manus of male not as narrow. Chela length to width ratio lower than 4.7 4
- 4 Largest species of the genus. Carapace length up to 13.6 mm, pectinal teeth 7–12 (usually 9–12), the three trichobothria on chela (dst, dsb, and db) in a smooth, shining, continuous sulcus *L. karschi* (Keyserling, 1885)
- Carapace length 6.6–11.8 mm, pectinal teeth 5–10 (usually 6–9), the three trichobothria on chela (dst, dsb, and db) on an irregular and granulated surface or rarely on smooth, shining, continuous surface *L. watigensis* (Gervais, 1843)
- 5 Total length of adults 22–36 mm. The color is uniformly brown to yellowish brown *L. australasiae* (Fabricius, 1775)
- Total length of adults 38 (probably immature female) – 49.1 mm. The color is uniformly black to blackish brown *L. nigripes* (Pocock, 1897)

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**A review of Chinese *Aphodius* species (Coleoptera: Scarabaeidae).  
Part 2: revision of the subgenus *Brachiaphodius***

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**Abstract.** The subgenus *Brachiaphodius* (genus *Aphodius* Illiger, 1798) species from the Palaearctic and the Oriental regions are revised. In addition to the eight currently known species, the following four new species are recognised: *Aphodius* (*Brachiaphodius*) *ahrensi* sp. n. from Nepal, *A. (B.) jendeki* sp. n. from Burma and Yunnan, *A. (B.) weibao* sp. n. from Yunnan, and *A. (B.) yuan* sp. n. from Yunnan and Vietnam. The following new synonyms are proposed: *Balthasarianus* Paulian, 1934 is a junior synonym of *Brachiaphodius* Koshantschikov, 1913, *Aphodius fruhstorferi* Petrovitz, 1970 is a junior synonym of *A. (Brachiaphodius) pilifer* Paulian, 1934 and *A. gregori* Balthasar, 1941 is a junior synonym of *A. (B.) pilosus* Harold, 1874. Lectotypes are designated for *A. (B.) babori* Balthasar, 1938, *A. (B.) pilifer* and *A. (B.) pilosus*. Male genitalia and epipharynges of all the species studied (except for *A. (B.) ahrensi* sp. n. and *A. (B.) rubripai* Masumoto, 1991, resp.) are figured. The palaearctic and oriental *Brachiaphodius* species are keyed. *A. (B.) pilifer* is recorded for the first time from Laos and Burma, *A. (B.) rubripai* Masumoto, 1991 is new to China (Yunnan), *A. (B.) nainiensis* Petrovitz, 1963 is new to the province of Meghalaya (India) and *A. (B.) pilosus* new to the province of Uttar Pradesh (India). The taxonomic status of *Brachiaphodius* and *Sinaphodius* Červenka, 1994 is briefly discussed.

**Taxonomy, new species, synonymy, lectotype designation, key, distribution, Scarabaeidae, *Aphodius*, *Brachiaphodius*, Palaearctic region, Oriental region**

INTRODUCTION

The subgenus *Brachiaphodius* was erected by Koshantschikov (1913) for *Aphodius pilosus* described by Harold (1874) from "Hindostan". In the same year Schmidt (1913: 135) described the subgenus *Trichaphodius* with the type species *Aphodius humilis* Roth, 1851, a widespread species in the Afrotropical region. In the excellent monograph by Schmidt (1922) the subgenus *Trichaphodius* covered twenty species including *A. pilosus*. In both mentioned studies by Schmidt (1913, 1922) the name *Brachiaphodius* is unfortunately omitted. The error is accepted by all the next authors (e. g., Paulian 1934, 1945, Balthasar, 1938, 1964, Petrovitz 1963, 1976, Stebnicka 1986; cf. also Masumoto, Dellacasa & Kiuchi 1990) till Dellacasa (1988). In addition, Paulian (1934) erected the subgenus *Balthasarianus* for *Aphodius pilifer* Paulian, 1934 described from Tonkin. In the world catalogue by Dellacasa (1988) the subgenus *Balthasarianus* comprised eleven valid species. Dellacasa (1988) is herewith the first author registering the name *Brachiaphodius* over again, but with only a question mark within the framework of the subgenus *Balthasarianus*, probably because he had no possibility to study Harold's type of *Aphodius pilosus*. Due to kind help of Yves Cambefort I had an opportunity to study the type (female) kept in the collection of R. Oberthür (MNHN). Based on the present study of this type specimen and material of all so far described "*Balthasarianus*" species from the Palaearctic and the Oriental regions, I assume the *Brachiaphodius* to be a valid subgenus of the genus *Aphodius* Illiger, 1798 (see also Discussion), with the name *Balthasarianus* as a junior synonym.

Thus the *Brachiaphodius* comprises twelve species occurring in the area studied including four new species described below (Fig. 52). One species, *Aphodius sinuatus* Harold, 1860 listed in Dellacasa (1988) as *Balthasarianus*, and three further species (*Aphodius philippinensis* and *A. yunnanensis*) described by Červenka (1994), were classified in the same paper in a separate subgenus *Smaphodius* Červenka, 1994 and *A. chitwanensis* Shoolmeesters et Van den Heuvel, 1999. Three afrotropical species (*Aphodius aureopilosus* Boucomont, 1930, *A. erinaceus* Balthasar, 1935, *A. jeanneli* Paulian, 1938) probably also belonging to the subgenus *Brachiaphodius* were not studied by the author.

## MATERIAL AND METHODS

Mouthparts of at least three specimens, if available, of each species studied, were dissected for examination of epipharyngeal structures. The dissected mouthparts were mounted in the Liquide de Swann on permanent slides and examined with stereoscopic microscope Meopta. All the permanent slides are deposited in DKCP. Illustrations of epipharynges were provided by means of the Provis AX70 (Olympus) microscope with digital image processing capability using Micro Image (Olympus) software. Morphological terminology concerning epipharyngeal structures was adopted from Dellacasa (1983).

The following codes (after Arnett et al. 1993) identify the collections housing the material examined.

- ABCC – Czech Republic, České Budějovice, Aleš Bezděk collection,
- DACD – Germany, Dresden, Dirk Ahrens collection,
- DFIC – Germany, Eberswalde-Finow, Deutsches Entomologisches Institut (L. Behne),
- DKCP – Czech Republic, Praha, David Kral collection,
- JSCP – Czech Republic, Praha, Jan Schneider collection,
- LMCT – Czech Republic, Tynec nad Labem, Ladislav Mencl collection,
- HNHM – Hungary, Budapest, Hungarian Natural History Museum (O. Merkl, G. Szeli),
- MHNG – Switzerland, Geneva, Muséum d'Histoire naturelle (I. Lobl),
- MNHN – France, Paris, Muséum national d'Histoire naturelle (Y. Cambefort),
- NHMB – Switzerland, Basel, Naturhistorisches Museum (M. Brancucci),
- NMPC – Czech Republic, Praha, National Museum (Natural History) (J. Jelínek),
- RCCP – Czech Republic, Praha, Radek Červenka collection,
- SMTD – Germany, Dresden, Staatliches Museum für Tierkunde (D. Ahrens),
- ZMAS – Russia, St. Petersburg, Zoological Museum, Academy of Sciences (B. M. Katsev, M. G. Volkovich),
- ZMHB – Germany, Berlin, Museum für Naturkunde der Humboldt Universität (F. Hieke, M. Uhlig).

Specimens of the newly described species are provided with one red printed label "[Name of a taxon] sp. n., HOLOTYPE, ALLOTYPE or PARATYPE with No. [male or female mark] David Kral det. 1997". In the case of lectotype and/or paralectotype designation, each specimen bears a red printed label "[Name of a taxon] LECTOTYPE or PARALECTOTYPE with No. [male or female mark] David Kral design. 1997". Exact label data are cited for the material, separate labels are indicated by slashes (/). Author's remarks and complementations are found in square brackets, [p] – preceding data within quotation are printed, [h] – the same but handwritten, MS – manuscript, HT – holotype, AT – allotype, PT – paratype, x/y – number of males / number of females.

## TAXONOMIC PART

### *Brachiaphodius* Koshantschikov, 1913

*Brachiaphodius* Koshantschikov, 1913: 200–201, figs 20–22, Dellacasa, 1988: 294, 371.  
*Balthasarianus* Paulian, 1934: 111, 1942: 81, 1945: 147, 164, Balthasar, 1943: 109, 1964: 22, 173–174.  
 Endrodi, 1960: 145, 1964: 6, 49, 147–148, Dellacasa, 1988: 287, 371 (type species *Aphodius pilifer* Paulian, 1934 by monotypy), **syn. n.**

TYPE SPECIES *Aphodius pilosus* (by monotypy)

REDESCRIPTION. Oblong, medium sized (6.0–9.3 mm) and moderately convex, uniformly brown coloured species. Dorsal surface setaceous, moderately shining, punctation relatively regular, coarse.



and dense. Head almost semicircular, anterior clypeal margin straight or only very shallowly emarginate, each side of emargination broadly rounded (Figs 46, 47), dorsal surface only very slightly convex at middle. Frontoclypeal and genal sutural lines slightly indicated, entirely absent from tubercles. Clypeal and genal margins rimmed. Epipharynx slightly sclerotized, only apotorma and pternotorma visibly sclerotized in most species. Anterior margin smooth, absent from notches, laterally either with weakly expressed lobes or straight, medial lobus absent. Epitorma not distinctly bordered, setaceous except for basal part. Anterior margin medially with dense row of long, robust setae confused laterally with those of acroparia. Chaetoparia with row of 19–48 long, robust setae. Chaetopodium with row of 5–19 long, robust setae. Acanthoparia and acroparia covered densely with setae of different lengths. Apophoba and ipophoba covered with numerous thin and short setae. Nesiun with U- or V-shaped, single or double row of densely spaced sensilla.

Pronotum with distinctly emarginate posterior angle, anterior and posterior margins absent from rim, lateral margin rimmed except for anterior angle, length of rim in posterior emargination variable. Scutellum small, triangulate. Macropterous. Anterior margin of profemur in both sexes with distinct, sharp denticle situated approximately in apical third of femur length (Figs 50, 51). Protibia in male considerably long and slim, rather bent ventromedially, with three sharp, almost rectangular external teeth, terminal spur plump, apically truncate, medioapically pointed, ventromedial edge in both sexes absent from denticles, with only row of considerably long, erect setae (Fig. 50). Apical margin and two well expressed carinae of meso- and metatibia fimbriate with setae strongly unequal in length. Inferior terminal spur of mesotibia in male absent. Claws moderately curved. Aedeagus in all known species relatively uniformly shaped, slim, laterally flattened, phallobasis ventrally absent from longitudinal membranous strip, in some species considerably long (almost four times longer than paramere), paramere ventrally setaceous, in some species with more or less expressed teeth.

***Aphodius (Brachiaphodius) ahrensi* sp. n.**  
(Figs 13–15)

*Aphodius (Balthasarianus) frusthorferi* Ahrens & Stebnicka 1997: 8, figs 11–15

TYPE MATERIAL. Holotype (male) labelled: NEPAL: HIMALAYA: Annapurna Mts. leg. Ahrens 1993 / Birethanti. Modi Khola. 17.6.900m [p] in DACD.

DESCRIPTION. Male (holotype). Body length 6.7 mm. Oblong, moderately convex, dorsal surface shining, except for head with very fine microreticulation, bearing pale, yellowish brown, recumbent setae, oriented posteriorly. Colour brown to piceous, antenna, mouthparts and extremities rather lighter.

Head large, almost semicircular, only very slightly convex at middle. Anterior margin of clypeus almost truncate, slightly upturned, side broadly regularly rounded, not separated from gena. Clypeal and genal margin distinctly rimmed. Gena regularly rounded, distinctly exceeding eye. Frontoclypeal and genal sutural lines slightly indicated, tubercles entirely absent. Punctuation simple, consisting of coarse, deeply impressed, densely and almost regularly distributed punctures, separated by approximately 1.5–2 their diameter.

Epipharynx (see Ahrens & Stebnicka 1997: 9, fig. 13). Anterior margin laterally with weakly expressed lobes, medially straight, medial lobus absent, lateral margins approximately regularly rounded along whole its length. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatium not distinctly bordered. Epitorma absent from medial group of setae, almost whole (except for basal part) covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter and sparser laterally and confused with those of acroparia. Chaetoparia with row of 21–22 long, robust setae. Chaetopodium with row of 13 long,

robust setae. Acanthoparia and acroparia with numerous setae, those being at acanthoparia distinctly shorter. Apophoba and ipohoba covered with numerous thin and short setae. Nesium with double row of irregularly and densely spaced sensilla.

Pronotum transversal, scarcely narrowed anteriorly, anterior angle rounded, slightly projecting anteriorly, side regularly broadly rounded toward shallowly but distinctly emarginate posterior angle, basal margin slightly projecting posteriorly, with weak sinuation each side. Anterior and posterior margins absent from rim, lateral margin distinctly rimmed, except for anterior angle, rim posteriorly reaching approximately to half of emargination of posterior angle. Punctuation similar but rather coarser than that on head. Lateral rim and basal margin with row of dense, short, posteriorly bent setae.

Scutellum triangulate, distinctly longer than wide, with several punctures.

Elytron short, ratio length to width of elytra combined = 1 : 1.25, widest approximately at middle, humerus in dorsal aspect finely denticulate. Striae narrow, moderately deeply impressed, stria punctures distinctly crenating interval margins, regularly distributed, separated by approximately 1.5 their diameter. Striae 1 and 10 completely developed, joining apically, striae 2–8 not joined posteriorly, striae 2–5 and 8–9 only very slightly shortened apically, striae 6–7 distinctly shortened, reaching approximately to 0.8 of elytral length, striae 6–7 shortened before humerus, stria 8 shortened basally, reaching almost 0.3 of elytral length. Intervals almost flat, except for narrow, distinctly convex, apically angustate sutural interval, intervals 2–8 discally approximately of the same width, punctuation dense, coarse, rather irregular.

Macropterous

Metasternal plate longer than wide, flat, shiny, absent from microreticulation, longitudinal line present, punctuation moderately impressed, irregular and sparse, marginally with row of dense punctures bearing long semierect setae.

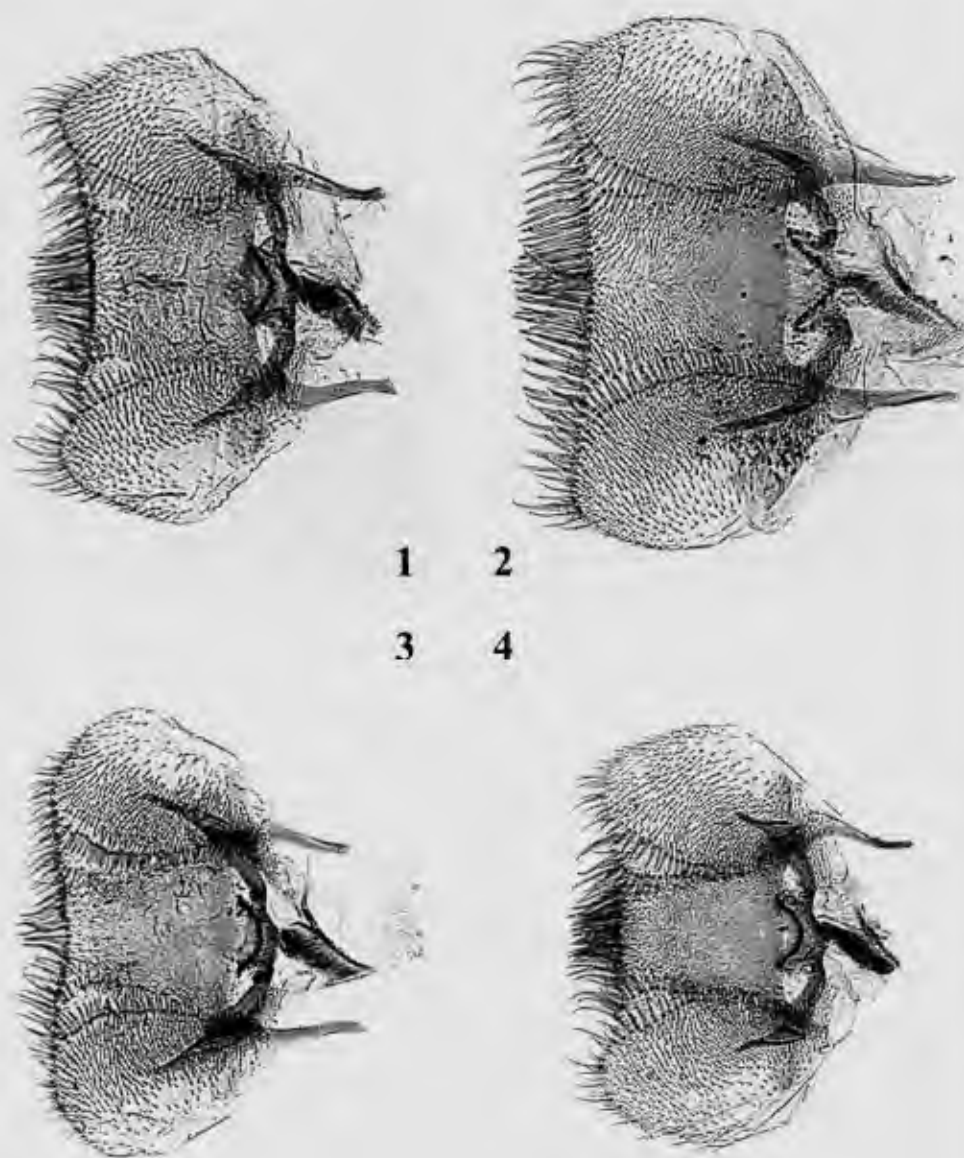
All femora coarsely, sparsely and rather irregularly punctate, each puncture bearing long semierect seta, anterior margin of profemur with distinct sharp denticle situated approximately in apical third of femur length. Protibia long and slim, rather bent ventromedially, with three sharp, almost rectangular external teeth and with row of 11 external denticles in basal two thirds, ventromedial edge absent from denticles, only with row of considerably long, erect setae, terminal spur shortened, plump, scarcely longer than wide, apically truncate, medioapically pointed. Apical margin and two well expressed carinae of meso- and metatibia fimbriate with setae strongly unequal in length. Basimesotarsomere distinctly longer than superior terminal spur, inferior terminal spur absent. Basimetatarsomere equal to superior terminal spur and distinctly longer than next three tarsomeres combined. Claws moderately curved.

Ventrites nearly alutaceous, finely shagreened, setaceous, setae double in size, consisting of dense, shorter, recumbent setae and transversal row of several long, regularly distributed setae. Aedeagus (Figs 13–15). Phallobasis relatively short, only little longer than paramere, paramere absent from ventral teeth.

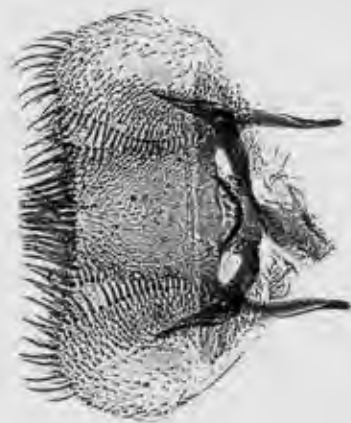
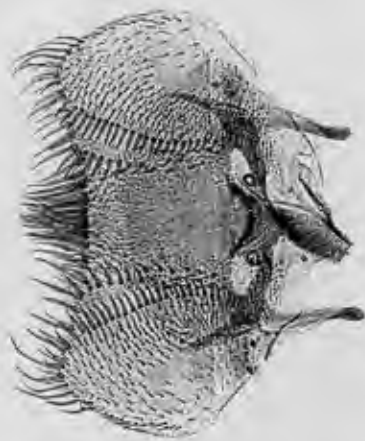
Female unknown

**DIFFERENTIAL DIAGNOSIS.** *Aphodius* (*Brachiaphodius*) *ahrensi* sp. n. is so far the only known *Brachiaphodius* species with microreticulated dorsal surface and short elytron. For differentiation from other species studied see the key below.

**NAME DERIVATION.** Patronymic, named in honour of my friend Dirk Ahrens (DADC), excellent student in Sericini and collector of the new species.



Figs. 1-4. Epipharynx. *Aphodius* (*Brachiaphodius*) *bahori* Baflhasar (Sichuan, Emei Shan) (1). *A. (B.) eccoptus* Bates (Japan, Tokio env.) (2). *A. (B.) jendeki* sp. n. (PT No 1) (3). *A. (B.) namensis* Petrovitz (Nepal, Anapurna Mt., Syange) (4). Scale bar = 0.3 mm.



5 6  
7 8



Figs 5-8 Epipharynx. *Aphodius* (*Brachyaphodius*) *pilifer* Paulian (Vietnam, Sa Pa) (5), *A. (B.) pilosus* Harold (Nepal, Langtang) (6), *A. (B.) ruihpai* Masumoto (Laos, Namtha prov.) (7), *A. (B.) taiwanicus* Petrovitz (Taiwan, Suishayao) (8). Scale bar = 0.3 mm.

***Aphodius (Brachiaphodius) babori* Balthasar, 1938**

(Figs 1, 16–18, 46)

*Aphodius (Balthasarianus) babori* Balthasar 1938: 8–10, 1964: 174–175, fig. 58; Masumoto 1977: 3, fig. 4, pl. 17; Dellacasa 1988: 94–371.

**TYPE LOCALITY:** China, Nitou – Tatsienlu [= Kangding], Prov. Szetschwan [= Sichuan] (Balthasar 1938).

**TYPE MATERIAL EXAMINED:** Lectotype (male) and paralectotypes No 1 (male) and Nos 2–3 (females) by present designation: labelled 'Nitou Tatsienlu [= Kangding] Szechuan China [p]' / Typus [p red label] / *Trichiphodius babori* n. sp. [Balthasar's MS] all in NMPC.

**ADDITIONAL MATERIAL EXAMINED:** China, pr. Sichuan, Emer Mt. 1000 m, 4–20.5.1989, 4/1 in DKCP, 2/0 in NHMB, China, W. Sichuan, 103°36'N, 31°00'E, Guan Xian, ca 1000 m, 1.8.1990, 1/0 in DKCP, Sichuan prov., 27 VI–3 VII 1991, Lajiping env., near Shimian, 200 km SW of Ya'an, 1/1 in DKCP.

**DIAGNOSTIC CHARACTERS:** Body length 7.4–7.8 mm. Dorsal surface without microreticulation. Gena regularly rounded, only inconspicuously exceeding eye (Fig. 46). Dorsal surface of head and pronotum almost regularly, coarsely and sparsely punctate, punctures separated by 1–1.5 their diameters. Emargination of posterior pronotal angle rimmed only in distal half. Elytron long, ratio length to width of elytra combined = 1.144–1.46, humerus in dorsal aspect absent from denticle, stria 8 distinctly shortened basally, reaching approximately 0.7 of elytral length, intervals 2–4 discally approximately of the same width. Terminal protibial spur in male plump, approximately as wide as long. Basimetatarsomere considerably longer than superior terminal spur (reaching approximately 0.7 of length of basimetatarsomere) and distinctly longer than next three tarsomeres combined.

Epipharynx (Fig. 1). Anterior margin laterally with only weakly expressed lobes, medially straight, medial lobus absent. Lateral margins in distal half nearly straight.

Basal parts (epitorma, proplegmatum, apotorma and pternotorma) only weakly sclerotized. Area of epitorma broadly triangulate, both epitorma and proplegmatum not distinctly rimed. Epitorma medially with 4–7 robust setae, in distal half and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter laterally and confused with those at acroparia. Chaetoparia with row of 20–26 long, robust setae. Chaetopodium covered with short row of 5–7 long, robust setae and numerous microtrichiae. Acanthoparia and lobes of acroparia with numerous long, thin setae becoming gradually shorter posteriorly. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with V-shaped, very dense row of sensilla.

Aedeagus (Figs 16–18). Phallobasis considerably long, about three times longer than paramere. Paramere ventrally with weak denticle in basal half.

**DISTRIBUTION:** China, Sichuan (Balthasar 1964); records from Taiwan (Masumoto 1977) likely concern *A. (B.) taiwanicus*.

***Aphodius (Brachiaphodius) eccoptus* Bates, 1889**

(Figs 2, 19–21)

*Aphodius eccoptus* Bates 1889: 297.

*Aphodius (Balthasarianus) eccoptus* Masumoto, Dellacasa & Kiuchi 1990: 150; Masumoto 1994: 370, pl. 66, 30.

*Aphodius (Acrossus) kochuensis* Matsumura 1934: 65; Balthasar 1964: 135; Dellacasa 1988: 149–363 (type locality: Minokuchi, Shinano [Japan], syn. by Masumoto, Dellacasa & Kiuchi 1990: 150).

**TYPE LOCALITY:** Nikkō, Japan (Bates 1889).



**MATERIAL EXAMINED.** Japan: Nippon Mayen, Env. de Tokio et Alpes de Niko, J. Harmand, 1901, 1/1 in DKCP, 2/1 spec. in MNHN; Karuizawa, 27 Sept. 1907, 9 spec. in MNHN, Kumanotaira, pr. Karuizawa, Japon, 12.7.1908, Edme Gallois, 1 spec. in MNHN; Japon, Etc. 1910, Edme Gallois, 1 spec. in MNHN; Iwate, Nippon, H. Yamamoto, 5.1936, 1/0 in DKCP, 0/2 in MHNG; Aizu, Japan, 3.6.1948, Y. Kurosawa leg., 1/0 in DKCP, 2/0 in HNHM; Aizu, 20 VII.1949, N. Japan, 2/0 in HNHG; Kasuga Hills, Nara, Japan, 18.5.1951, 0/1 in HNHM, Iwate, coll. Tesaf, 1/3 in MHNG; Japan, Kami Rodi, 2/3 in NMPC; Karuizawa, Japan, coll. Tesaf, 1 spec. in MNHN.

**DIAGNOSTIC CHARACTERS.** Body length 8.6–9.3 mm. Dorsal surface with fine microreticulation. Gena in male almost rectangular, in female regularly rounded, distinctly exceeding eye. Dorsal surface of head and pronotum rather irregularly, finely and sparsely punctate, punctures separated by approximately 2–4 their diameters. Emargination of posterior pronotal angle rimmed only distally. Elytron long, ratio length to width of elytra combined = 1.150–1.53, humerus in dorsal aspect absent from denticle, stria 8 only inconspicuously shortened basally, intervals 2–4 discally approximately of the same width. Terminal protibial spur in male plump, distinctly longer than wide. Basimetatarsomere equal to superior terminal spur and hardly longer than next three tarsomeres combined.

Epipharynx (Fig. 2). Anterior margin almost straight, lateral and medial lobes not expressed, lateral margins approximately regularly rounded along its whole length. Basal parts (epitorma, proplegmatum, apotorma and pternotorma) only weakly sclerotized. Area of epitorma broadly triangulate, not reaching anterior margin, both epitorma and proplegmatum not distinctly bordered. Epitorma absent from medial group of setae, in distal two thirds and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter laterally and confused with those at acroparia. Chaetoparia with row of 30–41 long, robust setae. Chaetopodium covered with short row of 9–14 long, robust setae and numerous microtrichiae. Acanthoparia and lobes of acroparia with numerous long, thin setae becoming gradually shorter posteriorly. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with V-shaped, very dense row of sensilla.

Aedeagus (Figs 19–21). Phallobasis short, only hardly longer than paramere. Paramere basally absent from teeth.

**DISTRIBUTION.** Japan (Masumoto 1994, Masumoto, Dellacasa & Kiuchi 1990, Matsumura 1934).

**REMARK.** The species was synonymized by Schmidt (1922) with *A. (B.) pilosus* and this incorrect action was accepted in the next papers dealing with these two taxa (e.g., Miwa 1931, Nomura & Nakane 1951, Balthasar 1964, Masumoto 1977, Dellacasa 1988). Only recently Masumoto, Dellacasa & Kiuchi (1990) and Masumoto (1994) indicated that it concerns two different species. This opinion is confirmed after studying the type of *A. pilosus* by the present author (see diagnostic characters of both species and the key below).

***Aphodius (Brachiaphodius) jendeki* sp. n.**  
(Figs 3, 22–24, 48)

**TYPE MATERIAL.** Holotype (male), allotype (female), and paratypes Nos 1–19 (males), Nos 20–34 (females), labelled: "CH, Yunnan, 14–21.6.1919, 100 km W of Baoshan, GAOLIGONGSHAN NAT. RES. [p]", paratypes Nos 35–48 (males), Nos 49–60 (females), labelled: "W. YUNNAN, 2200–2500 m, 24.57N 98.45E, 8.16.5.1995, GAO LIGONGSHAN mts [p]", paratypes Nos 61–123 (males), Nos 124–228 (females), labelled: "China, YUNNAN, 26.28.5.1995, GAOLIGONGSHAN mts, 90 km W of Baoshan [p]", paratypes No 229, 230 (males), No 231 (female), labelled: "NE Burma [= Myanmar], Kambaiti, 7000 ft, R. Malaise [lgt.] [p], 25–27/4.1934 [h]", paratype No 232 (male) labelled: "NE Burma, Kambaiti, 7000 ft, R. Malaise [lgt.] [p], 3–7/5.1934 [h]", paratype No 233 (male) labelled: "NE Burma, Kambaiti, 7000 ft, R. Malaise [lgt.] [p], 12/5.1934 [h]", paratype No 234 (female) labelled: "NE Burma, Kambaiti, 7000 ft, R. Malaise [lgt.] [p], 28/5.1934 [h]", paratype No 235 (male), labelled: "NE Burma, Kambaiti, 2000m, R. Malaise [lgt.] [p], 12.5.1934 [h]", paratype No 236 (female), labelled: "NE Burma, Kambaiti, 2000m, R. Malaise [lgt.] [p], 9.6.1934 [h]". Holotype, allotype and paratypes Nos 1–16, 30–34, 35–48, 49–60, 65–122, 134–229 in DKCP, paratypes Nos 123, 124–128 in ABCC, paratype Nos 61–64, 130–133 in MHNG, paratypes 17–29 in RCCP.



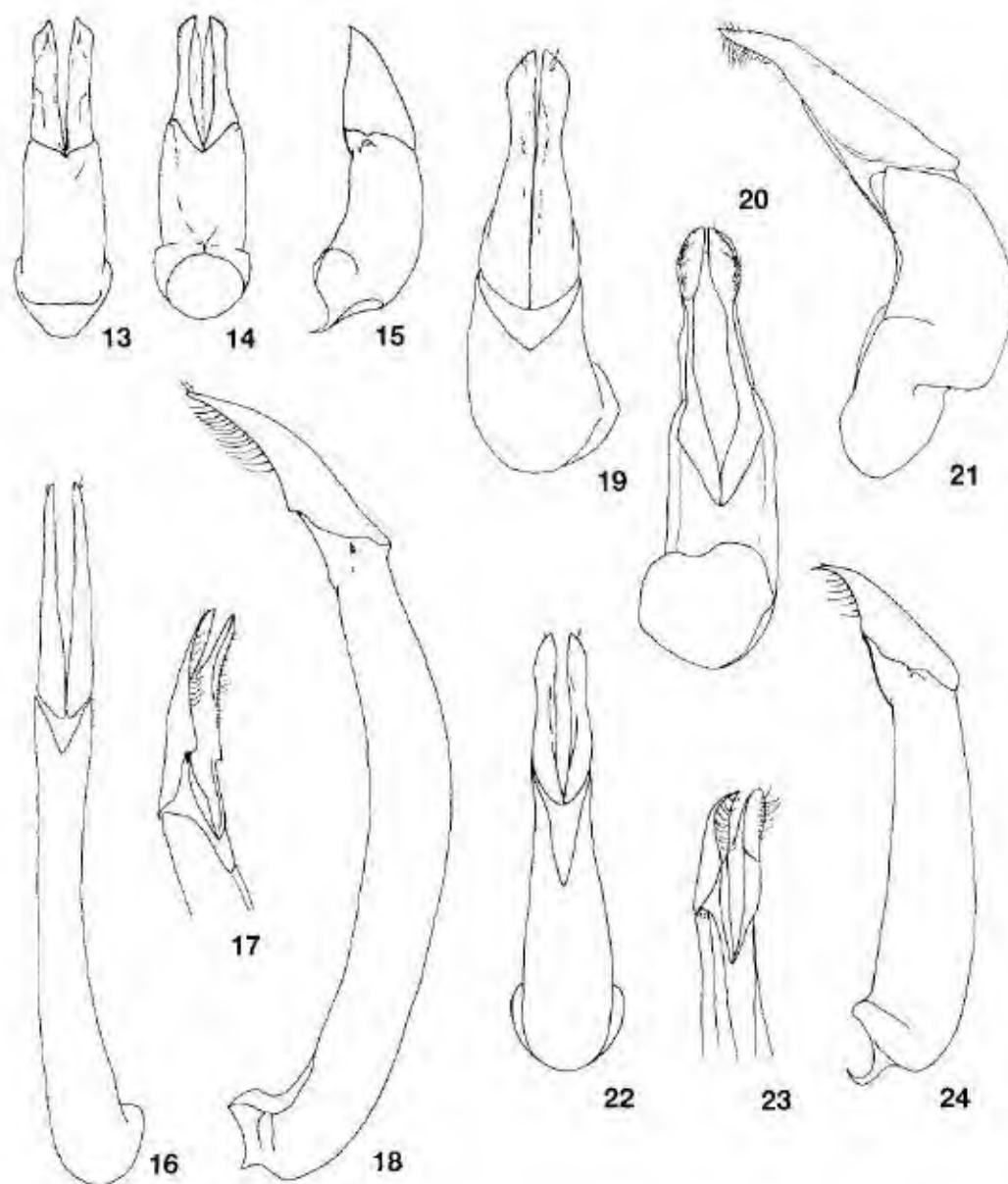


9 10

11 12



Figs 9-12. Epipharynx. *Aphodius* (*Brachiaaphodius*) *weibao* sp. n. (PT No. 1) (9), *A. (B.) yunnanensis* Masumoto (Thailand, Soppeng) (10), *A. (B.) yao* sp. n. (HT) (11), *A. (Sinaphodius) yunnanensis* Cervenka (PT - Yunnan, Jinghong) (12). Scale bar = 0.3 mm.



Figs 13-24. Parameres: *Aphodius* (*Brachyaphodius*) *ahrensi* sp. n. (HT) (13-15), *A.* (*B.*) *hubarti* Balthasar (Sichuan, Emei Shan) (16-18), *A.* (*B.*) *eccoptus* Bates (Japan, Iwate) (19-21), *A.* (*B.*) *jendeki* sp. n. (PT No 2) (22-24). Dorsal aspect (13, 16, 19, 22), ventral aspect (14, 17, 20, 23), lateral aspect (15, 18, 21, 24).

**DESCRIPTION.** Body length 6.9–7.6 mm (HT – 7.1 mm, AT – 7.4 mm). Oblong, moderately convex, dorsal surface with microreticulation, moderately shining, bearing pale, yellowish brown recumbent setae, oriented posteriorly. Colour brown to piceous, antennae, mouth parts and extremities, and in some specimens also pronotum rather lighter.

**Male.** Head large, almost semicircular, only very slightly convex at middle. Anterior margin of clypeus almost truncate, side broadly, regularly rounded, not separated by sinuation from gena. Clypeal and genal margins distinctly rimmed. Gena regularly rounded, distinctly exceeding eye. Frontoclypeal sutural line distinct, genal sutural line obsolete, tubercles entirely absent. Punctuation simple, consisting of coarse, deeply impressed, densely and almost regularly distributed punctures, separated by approximately 1–2 their diameters.

**Epipharynx** (Fig. 3). Anterior margin almost straight, lateral and medial lobe not expressed, lateral margins approximately regularly rounded along whole its length. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatium not distinctly bordered. Epitorma absent from medial group of setae, in distal two thirds and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter laterally and confused with those at acroparia. Chaetoparia with row of 39–48 long, robust setae. Chaetopodium with irregular double row of 8–12 short, robust setae and numerous microtrichiae. Acanthoparia and lobes of acroparia with numerous long, thin setae becoming gradually shorter posteriorly. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with shallowly U-shaped, very dense row of sensilla.

**Pronotum** transversal, scarcely narrowed anteriorly, anterior angle rounded, slightly projecting anteriorly, side regularly broadly rounded to shallowly but distinctly emarginate posterior angle, basal margin slightly projecting posteriorly, with weak sinuation each side. Anterior and posterior margins without rim, lateral margin distinctly rimmed, except for anterior angle, rim posteriorly reaching to approximately half of emargination of posterior angle. Punctuation the same as on head. Lateral rim and basal margin with dense pale row of posterolaterally bent setae.

**Scutellum** triangulate, distinctly longer than wide, with several punctures.

**Elytron** long, ratio length to width of elytra combined = 1.146–1.50, widest approximately at middle, humerus absent from denticle. Striae narrow, moderately deeply impressed, stria punctures distinctly crenating interval margins, regularly densely distributed, separated by approximately once their diameter. Striae 1 and 10 completely developed joining apically, striae 2–9 not joined posteriorly, striae 2–5 and 9 only very slightly shortened apically, striae 6–8 distinctly shortened, reaching approximately 0.8 of elytral length, striae 6–7 shortened before humerus, stria 8 shortened basally almost to 0.3 of elytral length. Intervals almost flat, except for narrow, distinctly convex, apically angustate sutural interval, intervals 2, 4, 6 and 8 distinctly wider discally than intervals 3, 5 and 7, punctuation approximately the same as on head and pronotum.

**Macropterous**

**Metasternal plate** longer than wide, flat, shiny, with fine microreticulation, longitudinal line entirely absent (only dark shade shown endocarina), punctuation consisting of fine, shallow and considerably irregular punctures medially and row of dense, fine rather regularly spaced punctures marginally, each puncture medially with shorter, recumbent seta, each puncture marginally with relatively longer semierect seta.

**All femora** sparsely, coarsely and rather irregularly punctate, each puncture bearing long, semierect seta, anterior margin of profemur with distinct sharp denticle in approximately apical third of femur length. Protibia long and slender, rather bent ventromedially, with three sharp, almost rectangular external teeth and with row of 9–11 external denticles in basal two thirds, ventromedial edge without denticles, only with row of considerably long, erect setae, terminal spur plump, shortened,

approximately as wide as long (Fig. 48), apically truncate, medioapically pointed. Apical margin and two well expressed transversal carinae of meso- and metatibia fimbriate with setae strongly unequal in length. Basimesotarsomere distinctly longer than superior terminal spur, inferior terminal spur absent. Basimetatarsomere longer than superior terminal spur and approximately equal to next three tarsomeres combined. Claws moderately curved.

Ventrites nearly alutaceous, finely shagreened, setaceous except for medial longitudinal band, setation double in size, consisting of dense shorter, recumbent setae and transversal row of several long, approximately regularly distributed setae.

Aedeagus (Figs 22–24) Phallobasis considerably long, nearly three times longer than paramere, paramere absent from ventral denticle, in lateral aspect curved ventrally.

Female differs from male by the following characters: profemoral denticle weakly developed, protibia shorter and wider, not distinctly bent ventromedially, with slender and apically pointed terminal spur, inferior terminal spur of mesotibia present, reaching approximately half of basimesotarsomere.

**DIFFERENTIAL DIAGNOSIS** *Aphodius* (*Brachiaphodius*) *jendeki* sp. n. is habitually most similar to *A. (B.) pilosus*. Both species exert the following identical diagnostic characters: dorsal surface microreticulated, elytron long, humerus absent from denticle, but the new species differs from *A. (B.) pilosus* in having elytral intervals 2 and 4 discally wider than interval 3, terminal protibial spur in male approximately as wide as long (Fig. 48), and paramere in lateral aspect straight (Fig. 33). For differentiation from the other species studied see the key below.

**COLLECTION CIRCUMSTANCES** The specimens originating from the Gaoligongshan Mts. were collected from horse dung on pathways in deciduous forest.

**NAME DERIVATION** Patronymic, named in honour of my friend Eduard Jendek (Bratislava, Slovakia), excellent student in Buprestidae, especially in the genus *Agrius*.

#### *Aphodius* (*Brachiaphodius*) *nainiensis* Petrovitz, 1963

(Figs 4, 25–27)

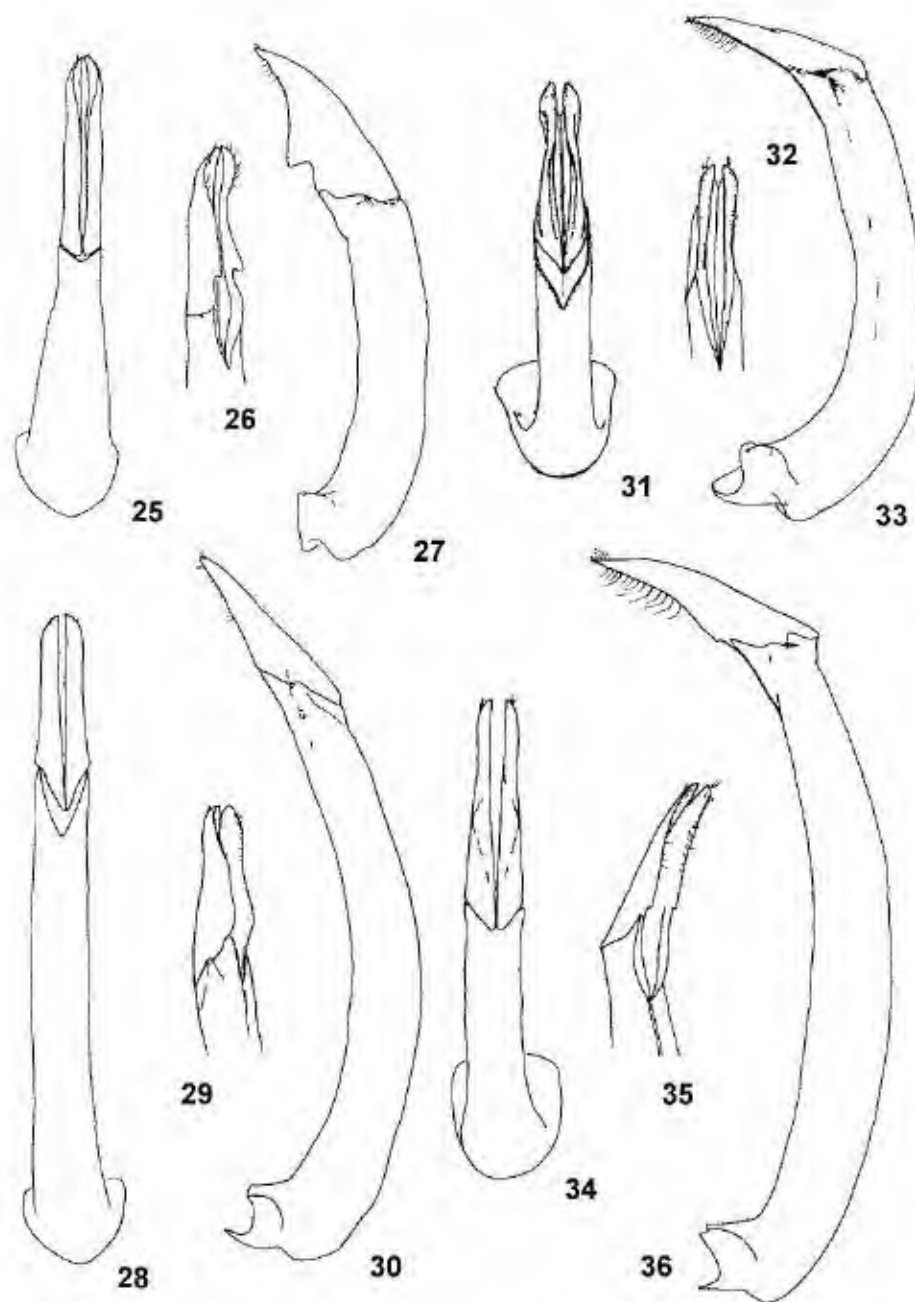
*Aphodius* (*Balthasarianus*) *nainiensis* Petrovitz, 1963: 631–632, Dellacasa, 1988: 233, 371, Stebnicka, 1989: 6–17, figs 19–21, Ahrens & Stebnicka, 1997: 8, 10, fig. 16.

**TYPE LOCALITY** Indien, Naini Tal, Bhim Tal (Petrovitz 1963).

**TYPE MATERIAL EXAMINED** "Naini Tal, India, Bhim Tal, 609 m, VIII 1961, leg. G. Scherer [p] / Paratypes [red p] / *Aph. (Balthasarianus) nainiensis* n. sp. Petrovitz [red p]", 2/3 in MHNG.

**ADDITIONAL MATERIAL EXAMINED** **India, Meghalaya:** India border, Meghalaya, W. Garo Hills, Nokrek Nat. Park, 25°29'5"N, 90°19'5"E, 1100 m, 9–17.5.1996, E. Jendek & O. Šauša lgt., 1/2 in RCCP, 0/1 in DKCP. **Uttar Pradesh:** India U.P., 1978, W. Wittmer / Bhimtal, 1400m, VI–VII, 1/1 in NHMB. India U.P. [Uttar Pradesh] Gangani, 1250m, 13–20.6.1981, 1/0 in DKCP, 4 spec. in NHMB. India – Uttar Pradesh north, Nainital [= Nainital] env., Bhimtal vill., 1400–1600 m, 6–10.8.1997, Jan Schneider lgt., 1/1 in DKCP, 8 spec. in JSCP. **Nepal:** Nepal-Himalaya, Annapurna-Mts., leg. Ahrens 1993 / Syange, 2750, Marsyangdi Khola, 1100m, 1/3 in DKCP.

**DIAGNOSTIC CHARACTERS** Body length 6.0–6.5 mm. Dorsal surface absent from microreticulation. Gena regularly rounded, distinctly exceeding eye. Dorsal surface of head and pronotum almost regularly, coarsely and densely punctate, punctures separated by approximately once their diameter. Emargination of posterior pronotal angle rimmed in approximately distal half. Elytron short, ratio length to width of elytra combined = 1.123–1.25, humerus in dorsal aspect finely denticulate, stria 8 distinctly shortened basally, reaching approximately 0.7 of elytral length, intervals 2–4 discally approximately of the same width. Terminal protibial spur in male plump, longer than wide. Basimet-



Figs 25-36. Parameres. *Aphodius* (*Brachiaphodius*) *naniensis* Petrovitz (Uttar Pradesh, Gangani) (25-27), *A.* (*B.*) *pilifer* Paulian (Vietnam, Sa Pa) (28-30), *A.* (*B.*) *pilosus* Harold (Nepal, Koshi) (31-33), *A.* (*B.*) *taiwanicus* Petrovitz (Taiwan, Fenchihu) (34-36). Dorsal aspect (25, 28, 31, 34), ventral aspect (26, 29, 32, 35), lateral aspect (27, 30, 33, 36).

atarsomere hardly longer than superior terminal spur and distinctly longer than next three tarsomeres combined

**Epipharynx** (Fig. 4) Anterior margin laterally with only very weakly expressed lobes, medially straight, medial lobus absent, lateral margins approximately regularly rounded along its whole length. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatium not distinctly bordered. Epitorma absent from medial group of setae, in distal two thirds and laterally covered with numerous microtrichiae. Anterior margin medially with considerably dense row of long, robust setae becoming sparser laterally and confused with those at acroparia. Chaetoparia with row of 28–36 long robust setae. Chaetopodium with short row of 8–12 long, robust setae, and sparse, very fine microtrichiae. Acanthoparia and lobes of acroparia with numerous long thin setae becoming gradually shorter posteriorly. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with shallowly U-shaped, very dense row of sensilla.

**Aedeagus** (Figs 25–27) Phallobasis considerably long, approximately two times longer than paramere, paramere ventrally distinctly denticulate.

**DISTRIBUTION** India: Uttar Pradesh (Stebnicka 1989), Nepal (Ahrens & Stebnicka 1997). First record from Meghalaya (India).

### *Aphodius (Brachiaphodius) pilifer* Paulian, 1934

(Figs 5, 28–30)

*Aphodius (Balthasarianus) pilifer* Paulian, 1934: 111, 1945: 164–165, Balthasar, 1964: 174–175, Dellacasa, 1988: 180–171.

*Aphodius (Balthasarianus) fruhstorferi* Petrovitz, 1970: 19–20, Stebnicka, 1986: 33, 1989: 7, Dellacasa, 1988: 233, 371 (type locality: Darjeeling), *syn. n.*

**TYPE LOCALITY** Hoa Binh, Tonkin [N Vietnam] (Paulian 1934)

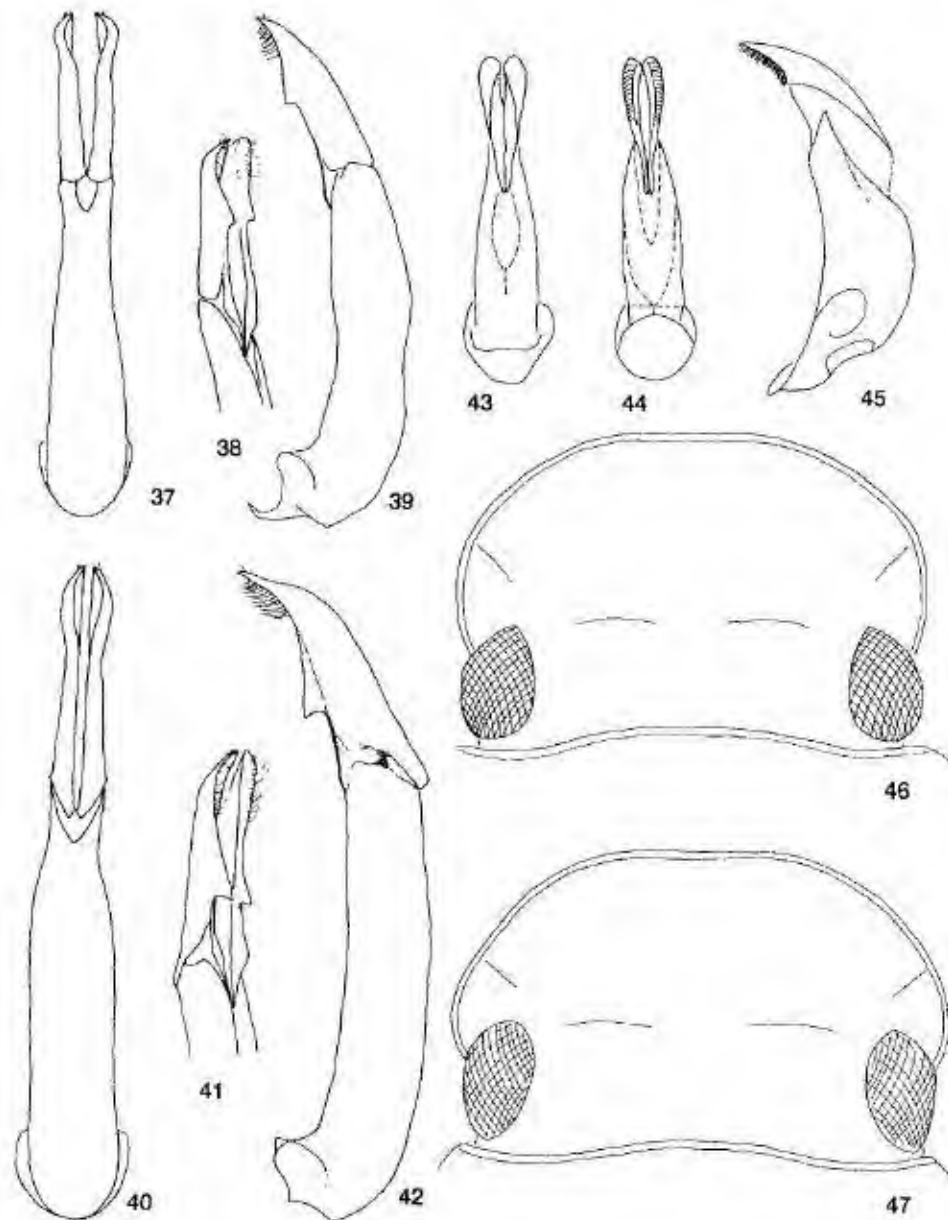
**TYPE MATERIAL EXAMINED** Lectotype (female) by present designation, labelled "Tonkin, Lar Tho, Hoa Binh. A. de Cooman {p} / TYPE [red p] / A. Balthasarianus pilifer Type [black ink, h] / pilifer Paul [Paulian' MST]", in MNHN. *Aphodius fruhstorferi*: "Darjeeling, Jun. 1 fruhstorfer leg [p] / mit Schultersdorn [Petrovitz's MS] / HOLOTYPE [red p] / Aph. (Balthasarianus) fruhstorferi n. sp. [red p]", 0/1 in MHNG. / Darjeeling, Jun. 1 fruhstorfer leg [p] / PARATYPE [red p] / Aph. (Balthasarianus) fruhstorferi n. sp. [red p]", 0/2 in MHNG.

**ADDITIONAL MATERIAL EXAMINED** **India, West Bengal**: Darjeeling, Jun. 1 fruhstorfer leg [p], 1/1 in MNHN. **Laos**: Laos, Louang Namtha pr., 21°09'N 101°19'E, Namtha→Muang Sing, 5–31 v 1997, 900–1200 m, Vit Kubañ leg., 1/2 in DKCP. **Myanmar**: Tenasserim, Tandong, 40000', Mai, fruhstorfer leg., 1/1 in DKCP, 1/3 in MNHN, 0/1 in female in ZMHB [in Ahrens & Stebnicka (1997) as *A. fruhstorferi*]. **Vietnam**: N Viet Nam (Tonkin), pr. Vin Phu 6–9.5 1990, Tam Dao, Vit Kubañ leg., 2/3 in DKCP, Vietnam N, Tam Dao, 900 m, 16–23 v 1991, Strnad Jan lgt., 5/6 in DKCP. Vietnam N, Hoang Lien Son prov., Sa Pa, 1500 m, 11–19.6 1990, 2/3 in DKCP, Vietnam N, Sa Pa, 1530 m, 25 v 9 VI 1991, Strnad Jan lgt., 1/4 in DKCP.

**DIAGNOSTIC CHARACTERS** Body length 6.7–7.5 mm. Dorsal surface absent from microreticulation. Gena regularly rounded, distinctly exceeding eye. Dorsal surface of head and pronotum coarsely, almost regularly punctate, punctures separated by approximately 1–1.5 their diameters. Emargination of posterior pronotal angle rimmed only in distal half. Elytron long, ratio length to width of elytra combined = 1.144–1.47, humerus in dorsal aspect finely denticulate, stria 8 distinctly shortened basally, reaching approximately 0.7 of elytral length, intervals 2–4 discally approximately of the same width. Terminal protibial spur in male plump, approximately as long as wide. Basimetatarsomere hardly longer than superior terminal spur and distinctly longer than next three tarsomeres combined.

**Epipharynx** (Fig. 5) Anterior margin laterally with only very weakly expressed lobe, medially straight, medial lobus absent, lateral margins approximately regularly rounded along its whole





Figs. 37-47. *Aphodius* (*Brachaphodius*) *weibao* sp. n. (PT No 2) (37-39), *A. (B.) yaannitnoi* Masumoto (Thailand, Seppong) (40-42), *A. (B.) yuan* sp. n. (HT) (43-45), *A. (B.) babori* Balthasar (Sichuan, Emei Shan) (46), *A. (B.) taiwanicus* Petrovitz (Taiwan, Fenchihu) (47). Parameres in dorsal aspect (37, 40, 43), the same but ventral aspect (38, 41, 44), the same but lateral aspect (39, 42, 45), head in dorsal aspect (46, 47).

length. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatum not distinctly bordered. Epitorma absent from medial group of setae, in distal two thirds and laterally covered with numerous microtrichiae. Anterior margin medially with considerably dense row of long, robust setae becoming sparser laterally and confused with those of acroparia. Chaetoparia with row of 23–30 long, robust setae. Chaetopodium with row of 12–16 long, robust setae, almost absent from microtrichiae. Acanthoparia and lobes of acroparia with numerous long thin setae becoming gradually shorter posteriorly. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with shallowly U-shaped, very dense row of sensilla.

Aedeagus (Figs 28–30) Phallobasis considerably long, nearly four times longer than paramere, paramere ventrally not denticulate.

DISTRIBUTION N Vietnam (Tonkin) (Paulian 1945, Balthasar 1964), record from Nepal (single female) by Stebnicka (1986) as *A. fruhstorferi* seems to be improbable in the author's opinion (see Remark below). First records from Laos and Myanmar.

REMARK *A. fruhstorferi* has been described from three females bearing a printed label "Darjeeling, Juni, Fruhstorfer". I had an opportunity to study specimens of *A. (B.) pilifer* kept in MNHN and one female in ZMHB, labelled "Tenasserim, Tandong, Mai, 40000', Fruhstorfer leg." Among them I have found also one couple (MNHN) with the same label as in types of *A. fruhstorferi*. After comparing them with type specimens of *A. fruhstorferi* I have learned that they are identical, including shape and structures of epipharynx, which means that all these specimens belong to the species *A. (B.) pilifer*, *A. fruhstorferi* being a junior synonym. In my opinion either in the Darjeeling area there are at least two species (*A. pilosus* and *A. pilifer*) or the labels "Darjeeling etc." of those specimens are incorrect. This could be reliably solved only after detailed knowledge of the distribution of *A. (B.) pilifer*.

### *Aphodius (Brachiaphodius) pilosus* Harold, 1874

(Figs 6, 31–33, 49–51)

*Aphodius pilosus* Harold, 1874: 183, Miwa, 1931: 283.

*Aphodius (Brachiaphodius) pilosus* Koshantschikov, 1913: 200–201, figs 20–22.

*Aphodius (Trichaphodius) pilosus* Schmidt, 1913: 136, 1922: 131, 138.

*Aphodius (Balthasarianus) pilosus* Balthasar, 1964: 174, 176, Dellacasa, 1988: 180, 371.

*Aphodius (Trichaphodius) gregori* Balthasar, 1941: 176–177.

*Aphodius (Balthasarianus) gregori* Balthasar, 1943: 109, 1964: 174, 175–176, Balthasar & Chujō 1966: 543.

Petrovitz, 1968: 38, Stebnicka, 1981: 325, 1986: 32, figs 65, 66, 1989: 7, 1990a: 7, Dellacasa, 1988: 136, 371.

Ahrens & Stebnicka, 1997: 8, fig. 14 (type locality Himalaya, Sikkim), **syn. n.**

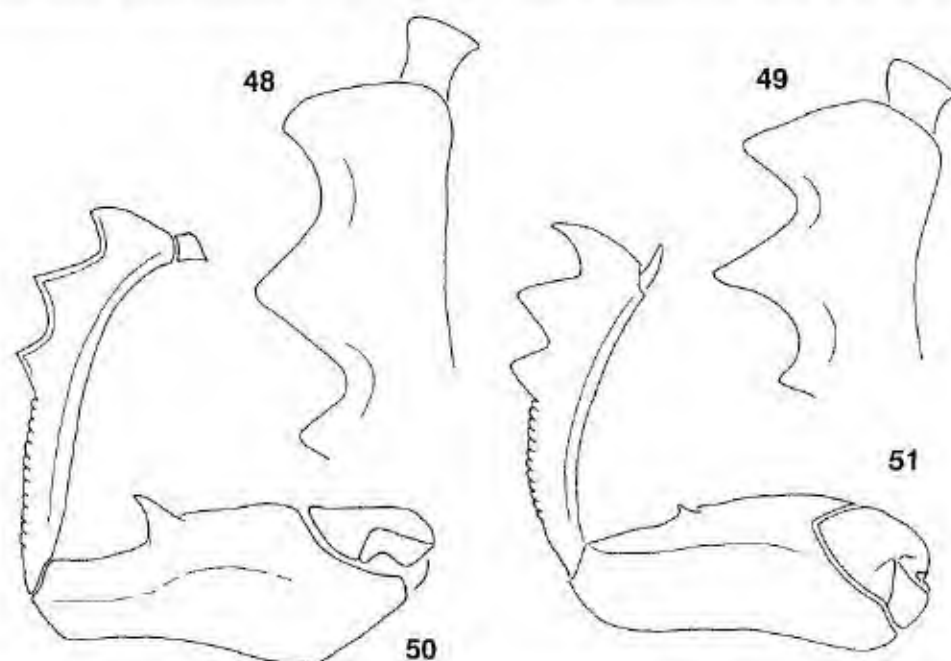
*Aphodius (Balthasarianus) abditus* Petrovitz, 1970: 18–19, figs 2a, b (type locality India, Darjeeling) (**syn. n.** by Stebnicka 1986: 32).

TYPE LOCALITY Hindostan [= India] (Harold 1874).

TYPE MATERIAL EXAMINED Lectotype (female), by present designation, labelled "India or pilosus Typ. Harold [black ink, Harold's MS] / Ex Musaeo B. Harold [p] / R. Paulian vidit [h]", in NHM *Aphodius abditus* "Darjeeling WB 2180 in VI 1961, leg. G. Scherer [p] / Holotypus [red p] / Aph. (Balthasarianus) abditus nov. Petrovitz [red p]", male in MHNG, "ditto but Paratypus [red p]", 6 spec. in MHNG, "Darjeeling Juni Fruhstorfer leg. [p] / Allotypus [red p] / Aph. (Balthasarianus) abditus nov. Petrovitz [red p]", female in MHNG, "ditto but Paratypus [red p]", 3 spec. in MHNG *Aphodius gregori*: "Nepal, Tukucha, 28°43' N Br 83°39' E, L., Turecha, 2550m, 10.9.1955, leg. F. Lobichler [p] / Aph. (Balthasarianus) gregori Balth. [Balthasar's MS] Allotypus [p] [red label]", male in NMPC.

ADDITIONAL MATERIAL EXAMINED **Bhutan** Bhutan, km 87 von Phuntsholing, 22.5.1972, 6 spec. in NHMB, Bhutan, Phuntsholing-Thumphu, 22.5.1972, 1680m, 1 spec. in NHMB, Bhutan, Thumphu, 30.5.1972, 6 spec. in NHMB, Bhutan, Thumphu, 31.5.1972, 2/0 in DKCP, 76 spec. in NHMB, Bhutan, Sampa-Kotoka, 1400–2600m, 9.6.1972, 11 spec. in NHMB, Bhutan, Gogona, 3100m, 10–12.6.1972, 5 spec. in NHMB, Bhutan, Nobding, 41km O

Wangdi Ph., 2800m, 17-18 6 1972, 5 spec. in NHMB, Bhutan, Dehki Paka, 3300m, 20 6 1972, 11 spec. in NHMB, Bhutan, Changra, 18km S Tongsa, 1900m, 22 6 1972, 1 spec. in NHMB, Bhutan, Thimphu, 26-29 6 1972, 4 spec. in NHMB, Bhutan, K. Nishioka, Ha Valli, 28 6 1972, 3 spec. in NHMB, Bhutan, Paro, 2300m, 8 1972, K. Nishioka, 18 spec. in NHMB, Bhutan, Bumthang, 7 1974, F. Maurer, 1 spec. in NHMB, West Bhutan, Paro Distr., Gedu, 17-26 6 1988, 2100m, leg. C. Holzschuh, 5/6 in DKCP India, Uttar Pradesh, India, Himalaya, U. P. [Uttar Pradesh], District Dehra Dun, Mussoorie, 1-4 6 1981, leg. C. Holzschuh, 3/2 in DKCP N. India, Uttar Pradesh, 2300 m, 10 km W Mussoorie, 17 Aug. 1985, leg. J. Schulze, 0/1 in DKCP, 0/3 in ZMHB, Himalay Baghiratti r., Dobrani, 18 9 1989, 0/1 in DKCP, Himalay, Baghiratti r., Uttarkashi, 18 9 1989, 1/3 in DKCP West Bengal, Bengal, Kurseong, VI-53, di. Serio, 1/0 in MHNG, Indien, Darjeeling Distr., Jombuke, 1V 1985, Ch. J. Rai lgt., 1 spec. in NHMB, Baluwa Khari, 2700m (KPG [Kalimpong]), 23 5 1986, India, Darjeeling Ch. J. Rai lgt., 1 spec. in NHMB, Darj. [eeeling], 0/1 in MNHN, Darjeel [ing], 1 spec. in MNHN, Darjeeling, Juni, Fruhstorfer leg., 0/2 in DEIC, 0/2 in MNHN, 1- W Bengal, 8-10 5 1991, Darjeeling env., 1800-2500m, St. Jakl lgt., 3/4 in DKCP Nepal, Nepal, Jiri, 1900m, 17-19 5 1962, leg. G. Ebert, 14 spec. in NMPC, Syabru, 12 6 1978, 2200-3350m, Nepal, Bhakta B., 7 spec. in NHMB, Nepal, Chandam bari, 3350 m, 22 6 1978, Bhakta B., 1 spec. in NHMB, O. Nepal, Lamobagar Gao, 1400m, 28-31 5 1980, W. Wittmer lgt., 1 spec. in NHMB, O. Nepal, Arunthan Chuchila, 1300-1950m, 23 5 1980, W. Wittmer lgt., 1 spec. in NHMB, O. Nepal, Hong Gaon-Hatrya, 1 6 1980, 2300-1550m W. Wittmer lgt., 2 spec. in NHMB, O. Nepal, W. Wittmer lgt., Tashigaon, 2100m, 14 6 1980, 55 spec. in NHMB, Nepal, Pasgaon, (3500-4200m), 10 10 1980, Dr. A. Hamet lgt., E. Nepal, Arun, Mare, 2000m, 2-8 6 1983, M. Brancucci lgt., 21 spec. in NHMB, Sakhu, 1400m, 17 6 1983, Nepal, Kathmandu, M. Brancucci lgt., 2 spec. in NHMB, Lamobagar Goal, 1400m, 8-14 6 1983, E. Nepal, Arun, M. Brancucci lgt., 5 spec. in NHMB, E. Nepal, Koski, Basantapur, 2300m, 30 5-2 6 1985, M. Brancucci lgt., 2 spec. in NHMB, E. Nepal, Koshi, M. Brancucci lgt., Chauki-Gufa, 2700-2800m, 3 VI 1985, 1/0 in DKCP, Nepal, Bagmati, Sindhupalchok, Samatang-Gangwal, 2500m, 5 6 1989, M. Brancucci lgt., 1 spec. in NHMB, Nepal, Bagmati, Sindhupalchok, Gangwal, 2500m, 6-7 VI 1989, M. Brancucci lgt., 1/0 in DKCP, 6 spec. in NHMB, Nepal, Bagmati, Sindhupalchok, Parahang-Depkakharka, 2500-1700m, 10 6 1989, M. Brancucci lgt., 36 spec. in NHMB, Nepal,



Figs 48-51. *A. (B.) jendeki* sp. n. (PT No 1) (48), *A. (B.) pilosus* Harold (Nepal, Koshi) (49-51). Terminal spur of left protibia in male in dorsal aspect (48, 49), right foreleg in male in ventral aspect (50), the same but female (51).

30.5.1990, Langtang Nat. Park, Dunche, 2000m, S. Bily leg., 8/10 in DKCP **Sikkim** British India, Sikkim Lachen Lachung 0/1 in MNHN, Himalaya Sikkim, 3/0 males in ZMHB India or, 0/1 in MNHN

**DIAGNOSTIC CHARACTERS** Body length 6.5–8.0 mm. Dorsal surface finely transversally microreticulate. Gena almost regularly rounded, distinctly exceeding eye. Dorsal surface of head and pronotum finely, sparsely and almost regularly punctate, punctures separated by approximately 2–3 their diameters. Emargination of posterior pronotal angle rimmed only in distal half. Elytron long, ratio length to width of elytra combined = 1.148–1.55, humerus in dorsal aspect absent from denticle, stria 8 distinctly shortened basally, reaching approximately 0.7 of elytral length, intervals 2–4 discally approximately of the same width. Terminal protibial spur in male plump, wider than long (Fig. 49). Basimetatarsomere hardly longer than superior terminal spur and approximately equal to next three tarsomeres combined.

**Epipharynx** (Fig. 6). Anterior margin almost straight, lateral and medial lobe not expressed, lateral margins approximately in distal half straight and divergent posteriorly, in proximal half regularly rounded. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatum not distinctly bordered. Epitorma absent from medial group of setae, in distal two thirds and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter and sparser laterally and confused with those of acroparia. Chaetoparia with row of 19–23 long, robust setae. Chaetopodium with row of 14–19 long, robust setae, almost absent from microtrichiae. Acanthoparia and lobes of acroparia with numerous long setae becoming gradually shorter posteriorly. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with shallowly U-shaped, very dense row of sensilla.

**Aedeagus** (Figs 31–33). Phallobasis considerably long, almost four times longer than paramere, paramere ventrally not denticulate, in lateral aspect apically straight.

**DISTRIBUTION** Bhutan (Stebnicka 1981), India (Schmidt, 1922; Miwa 1931, Balthasar 1964), India Meghalaya (as Assam – Khassia Hills) (Koshantschikov 1913), West Bengal (Petrovitz 1970, Stebnicka 1986), Nepal (Balthasar & Chujo 1966, Petrovitz 1968, Stebnicka 1981, 1986, 1989, 1990a, Ahrens & Stebnicka 1997), Sikkim (Koshantschikov 1913, Balthasar 1941, 1943, Stebnicka 1981, 1986). First record from Uttar Pradesh (India).

**REMARK** Records from Japan (Schmidt 1922, Miwa 1931, Balthasar 1964) are concerned *A. (B.) eccoptus* (see Remark by *A. (B.) eccoptus*), records from Trichinopoly [= Tiruchirappalli], Tamil Nadu prov., south India (Koshantschikov 1913) and from Taiwan (Miwa 1931, Balthasar 1964) are improbable with respect to the distribution area of *A. (B.) pilosus*.

### *Aphodius (Brachiaphodius) ruubpai* Masumoto, 1991

(Fig. 7)

*Aphodius (Balthasarianus) ruubpai* Masumoto, 1991: 31–32, figs 3, 11, 18, Dellacasa, 1996: 165–168.

**TYPE LOCALITY** Meo Will [= vill] – Doi Suthep, Chiang Mai Prov., Northwest Thailand (Masumoto 1991).

**MATERIAL EXAMINED** **China, Yunnan** Yunnan, Baoshan env., 23.6.1995, 0/2 in DKCP. **Thailand** Than, 14/5.1993, 19.16N–98.35 E, Doi Mae Ya. Vit Kuban leg., 0/1 in LMCT.

**DIAGNOSTIC CHARACTERS** Body length 6.0–6.2 mm. Dorsal surface absent from microreticulation. Gena regularly rounded, distinctly exceeding eye. Dorsal surface of head and pronotum almost regularly, coarsely and densely punctate, punctures separated by approximately once their diameter. Whole emargination of posterior pronotal angle rimmed. Elytron short, ratio length to width of elytra combined = 1.126–1.32, humerus in dorsal aspect finely denticulate, stria 8 distinctly

shortened basally, reaching approximately 0.7 of elytral length, intervals 2–4 discally approximately of the same width. Terminal protibial spur of male not studied. Basimetatarsomere hardly longer than superior terminal spur and distinctly longer than next three tarsomeres combined.

**Epipharynx** (Fig. 7). Anterior margin almost straight, lateral and medial lobe not expressed, lateral margins approximately regularly rounded along its whole length. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatum not distinctly bordered. Epitorma absent from medial group of setae, in distal three fourths and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter and sparser laterally and confused with those of acroparia. Chaetoparia with row of 20–24 long, robust setae. Chaetopodium with row of 7–11 long, robust setae, almost absent from microtrichiae. Acanthoparia and acroparia with numerous setae, those at acanthoparia being distinctly shorter. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with shallowly U-shaped, very dense row of sensilla.

**Aedeagus** (see Masumoto 1991, fig. 18). Phallobasis considerably long, approximately two times longer than paramere, paramere ventrally finely denticulate.

**DISTRIBUTION**. Northern Thailand. First record from China (Yunnan).

***Aphodius (Brachiaphodius) taiwanicus* Petrovitz, 1976**  
(Figs 8, 34–36, 47)

*Aphodius (Balthasarianus) taiwanicus* Petrovitz 1976: 6–8. Dellacasa 1989: 233–371.

*Aphodius (Balthasarianus) baboti* Stebnicka 1990b: 897.

**TYPE LOCALITY**. Formosa [= Taiwan] (Petrovitz 1976).

**TYPE MATERIAL EXAMINED**. <sup>1</sup> Suisharyo Formosa: H. Sauter X 1911 [p] / Allotypus [p, red label] / *Aph. (Balthasarianus) taiwanicus* nov. spec. Petrovitz [p, red label] / *A. baboti* Blth. = *taiwanicus* syn. nov. det. Z. Stebnicka [Stebnicka's MS] 0/1 in MHNG.

**ADDITIONAL MATERIAL EXAMINED**. **Taiwan**: Koschipo Formosa: H. Sauter 22.5.1912 2/2 in DEIC. Suisharyo Formosa: H. Sauter X 1911 2/1 in DEIC. Taiwan IV VI 77 Fenchihu 1400 m J. & S. Klapperich 9 spec. in MHNG. Taiwan: Mitaka jama 3 spec. in MHNG.

**DIAGNOSTIC CHARACTERS**. Body length 6.2–7.2 mm. Dorsal surface absent from microreticulation. Gena regularly rounded, weakly but distinctly exceeding eye (Fig. 47). Dorsal surface of head and pronotum almost regularly, relatively finely punctate, punctures separated by approximately once their diameters. Emargination of posterior pronotal angle rimmed in approximately distal half. Elytron long, ratio length to width of elytra combined = 1.152–1.154, humerus in dorsal aspect absent from denticle, stria 8 distinctly shortened basally, reaching approximately 0.7 of elytral length, intervals 2–4 discally approximately of the same width. Terminal protibial spur in male plump, approximately as wide as long. Basimetatarsomere hardly longer than superior terminal spur and distinctly longer than next three tarsomeres combined.

**Epipharynx** (Fig. 8). Anterior margin laterally with only weakly expressed lobe, medially straight, medial lobe absent, lateral margins approximately in distal half straight and divergent posteriorly, in proximal half regularly rounded. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatum not distinctly bordered. Epitorma medially with 9–12 robust setae and 3–4 sensilla, in distal two thirds and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter laterally and confused with those at acroparia. Chaetoparia with row of 19–22 long robust setae. chaetopodium covered with short row of 5–9 long, robust setae and numerous microtrichiae. Acanthoparia and lobes of acroparia with numerous long setae being distinctly shorter than those of acanthoparia. Apophoba and



apophoba covered with numerous thin and short setae. Nesium with V-shaped, very dense row of sensilla.

Aedeagus (Figs 34–36) Phallobasis considerably long, about three times longer than paramere, paramere ventrally with subobsolete denticle.

DISTRIBUTION Taiwan

REMARKS This species was synonymized by Stebnicka (1990) with *A. (B.) babori*. Based on a comparison of type specimens of both species I have learned that there are two habitually very similar but valid species, for the differentiation from each other see diagnostic characters of both species and the key below.

*Aphodius (Brachiaphodius) weibao* sp. n.

(Figs 9, 37–39)

TYPE MATERIAL Holotype (male), allotype (female), and paratypes Nos 1–21 (males), Nos 22–45 (females), labelled "Yunnan, 2000–2800 m, 25°11'N 100°24'E, Weibaoshan mts., W slope, 25–28/6 [19]92 [p]", paratype No 46 (male) labelled "Yunnan, 25°04'N 101°55'E, Yipinglang, 1800–2000 m, 17–20 vi 1994 [p]", paratypes Nos 47, 48 (males), No 49 (female), labelled "Yunnan, 25°38'N 100°09'E, Cangshan, 2800 m, 6 vi 1993, [p]". Holotype, allotype and paratypes 1–18, 22–42, 46–49 in DKCP, paratypes Nos 19, 20, 43, 44 in MHNG, paratypes Nos 21, 45 in RCCP.

DESCRIPTION Body length 6.5–7.3 mm (HT – 6.7 mm, AT – 6.8 mm). Oblong, moderately convex, dorsal surface absent from microreticulation, strongly shining, bearing pale, yellowish brown recumbent setae, oriented posteriorly. Colour brown to piceous, antennae, mouthparts and extremities rather lighter.

Male. Head large, almost semicircular, only very slightly convex at middle. Anterior margin of clypeus truncate, slightly upturned, side broadly, regularly rounded, not separated by sinuation from gena. Clypeal and genal margins distinctly rimmed. Gena regularly rounded, distinctly exceeding eye. Frontoclypeal and genal sutural lines distinct, tubercles entirely absent. Punctuation simple, consisting of considerably coarse, deeply impressed, densely and almost regularly distributed punctures, separated by approximately once to rarely twice their diameter.

Epipharynx (Fig. 9). Anterior margin laterally with only weakly expressed lobe, medially straight, medial lobe absent, lateral margins approximately regularly rounded along its whole length. Only apotorma, pternotorma and anterior lobes visibly sclerotized, epitorma and proplegmatium not distinctly bordered. Epitorma absent from medial group of setae, in distal three fourths and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming sparser laterally and confused with those of acroparia. Chaetoparia with row of 25–29 long, robust setae. Chaetopodium with shortened row of 7–11 long, robust setae. Acanthoparia and acroparia with numerous setae, those at acanthoparia being distinctly shorter. Apophoba and ipophoba covered with numerous thin and short setae. Nesium with shallowly U-shaped, very dense row of sensilla.

Pronotum transversal, scarcely narrowed anteriorly, anterior angle rounded, slightly projecting anteriorly, side regularly broadly rounded toward shallowly but distinctly emarginate posterior angle, basal margin slightly projecting posteriorly, with weak sinuation each side. Anterior and posterior margins without rim, lateral margin distinctly rimmed, except for anterior angle, rim posteriorly reaching approximately half of emargination of posterior angle. Punctuation the same as that on head. Lateral rim and basal margin with row of dense, short, posteriorly bent setae.

Scutellum triangulate, distinctly longer than wide, with several punctures.

Elytron long, ratio length to width of elytra combined = 1.43–1.50, widest approximately at middle, humerus in dorsal aspect finely denticulate (in some specimens denticle subobsolete). Striae



narrow, moderately deeply impressed; stria punctures distinctly crenating interval margins, regularly distributed, separated by approximately once their diameter. Striae 1 and 10 completely developed, joining apically, striae 2-9 not joined posteriorly, striae 2-5 and 9 only very slightly shortened apically, striae 6-8 distinctly shortened, reaching approximately 0.8 of elytral length; striae 6-7 shortened before humerus, stria 8 shortened basally, reaching almost 0.3 of elytral length. Intervals almost flat, except for narrow, distinctly convex, apically angustate sutural interval; intervals 2-8 discally approximately of same width; punctuation scarcely sparser than on head and pronotum.

#### Macropterous.

Metasternal plate longer than wide, flat, shiny, absent from microreticulation, longitudinal line indicated anteriorly and posteriorly, broadly interrupted medially; punctuation consisting of fine, shallow and considerably irregular punctures anteriorly and medially and row of dense, fine almost regularly spaced punctures marginally; each medial and anterior puncture with rather short recumbent seta, each marginal puncture with relatively longer semierect seta.

All femora shiny, densely, coarsely and almost regularly punctate, each puncture bearing long, semierect seta; anterior margin of profemur with distinct, sharp denticle, situated in approximately apical third of femur length. Protibia long and slim, rather bent ventromedially, with three sharp, almost rectangular external teeth and with row of 9-11 external denticles in basal two thirds; ventromedial edge without denticles, with only considerably long, erect setae; terminal spur shortened,

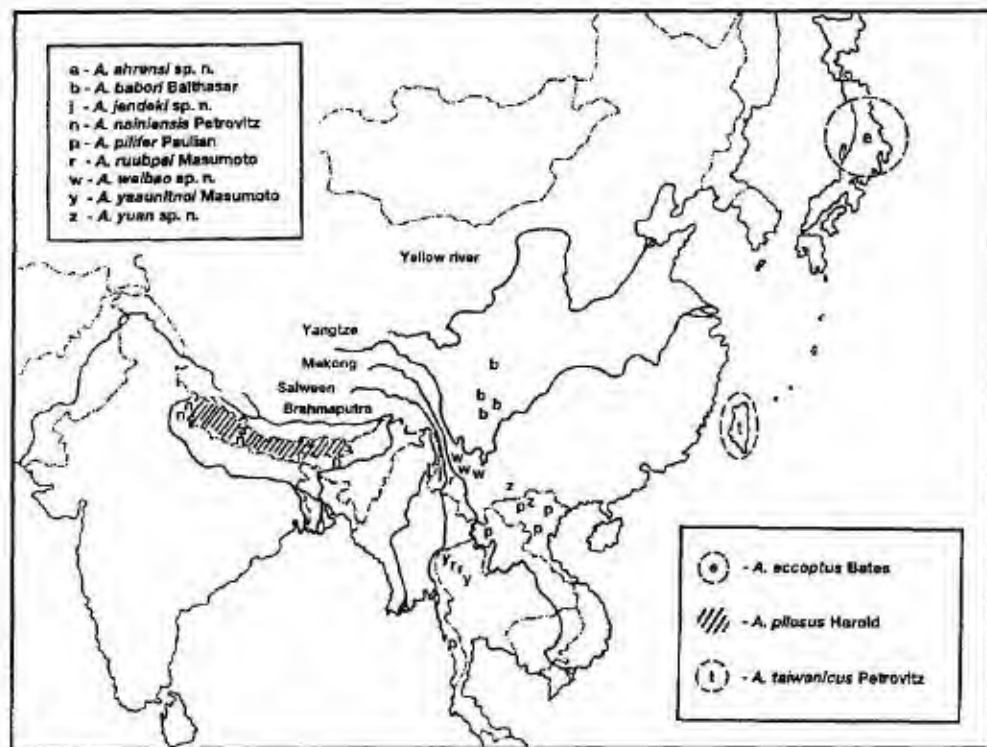


Fig. 52. Known distribution of the palaearctic and oriental *Brachiaphodius* representatives.

plump, apically truncate, medioapically pointed. Apical margin and two well expressed transversal carinae of meso- and metatibia fimbriate with setae strongly unequal in length. Basimesotarsomere distinctly longer than superior terminal spur, inferior terminal spur absent. Basimetatarsomere scarcely longer than superior terminal spur and distinctly longer than next three tarsomeres combined. Claws moderately curved.

Ventrites moderately shiny, shagreened, distinctly setaceous, setation pale, double in size, consisting of dense, shorter, recumbent setae and transversal row of several, long, approximately regularly distributed, erect setae.

Aedeagus (Figs 37–39). Phallobasis considerably long, about two times longer than paramere, ventral denticle weakly developed and situated slightly before half of paramere length.

Female differs from male by the following characters: profemoral denticle weakly developed, protibia shorter and wider, not distinctly bent ventromedially, with slim and apically pointed terminal spur, inferior terminal spur of mesotibia present, reaching approximately to half of basimesotarsomere.

**DIFFERENTIAL DIAGNOSIS.** *Aphodius (Brachiaphodius) weibao* sp. n. is habitually most similar to *A. (B.) yaaunitnoi*. Both the species exert the following identical diagnostic characters: dorsal surface absent from microreticulation, elytron long, elytral humerus finely denticulate, terminal spur of protibia in male longer than wide, although the new species differs from *A. (B.) yaaunitnoi* in having punctuation of pronotum almost regular, fine and dense, punctures separated by approximately once their diameter, rarely by 1.5 their diameter, denticle of ventral side of paramere weakly expressed and situated slightly before half of paramere length (Fig. 39). For differentiation from the other species studied see the key below.

**COLLECTION CIRCUMSTANCES.** The specimens of the type series originating from the Weibaoshan Mts. were taken from horse dung at western slope covered with deciduous forest.

**NAME DERIVATION.** The specific name of the new species refers to the type locality, the Weibaoshan Mts., situated south of the Erhai lake, noun in apposition.

***Aphodius (Brachiaphodius) yaaunitnoi* Masumoto, 1991**  
(Figs 10, 40–42)

*Aphodius (Brachiaphodius) yaaunitnoi* Masumoto, 1991: 32–33, figs 6, 13, 20. *Dollacasa* 1996: 166–168.

**TYPE LOCALITY.** Muang Pan, Lampang Prov., Northwest Thailand (Masumoto 1991).

**MATERIAL EXAMINED.** **Thailand:** Thai 10: 13/5 1993, 19°27'N 98°20'E, Soppong, 1550 m. Vit. Kuban leg. 0/1 in DKCP. Thai 17: 31/5 1995, 19°27'N 98°20', Soppong, 1500 m. Vit. Kuban leg. 1/1 in DKCP.

**DIAGNOSTIC CHARACTERS.** Body length 7.3–7.6 mm. Dorsal surface absent from microreticulation. Gena regularly rounded, distinctly exceeding eye. Dorsal surface of head and pronotum coarsely, somewhat irregularly and relatively sparsely punctate, punctures separated in most cases by twice their diameter. Emargination of posterior pronotal angle in distal half rimmed. Elytron long, ratio length to width of elytra combined = 1.142–1.44, humerus in dorsal aspect finely denticulate, stria 8 distinctly shortened basally, reaching approximately 0.7 of elytral length, intervals 2–4 discally approximately of the same width. Terminal protibial spur in male plump, distinctly longer than wide. Basimetatarsomere longer than superior terminal spur and longer than next three tarsomeres combined.

Epipharynx (Fig. 10). Anterior margin laterally with weakly expressed lobes, medially straight, medial lobus absent, lateral margins approximately in distal half straight and divergent posteriorly, in proximal half regularly rounded. Only apotorma and pternotorma visibly sclerotized, epitorma

and proplegmatium not distinctly bordered. Epitorma absent from medial group of setae, in distal two thirds and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming shorter and sparser laterally and confused with those of acroparia. Chaetoparia with row of 24–29 long, robust setae. Chaetopodium with short row of 6–9 long, robust setae, almost absent from microtrichiae. Acanthoparia and acroparia with numerous long setae, those at acanthoparia being distinctly shorter. Apophoba and ipophoba covered with numerous thin and short setae. Nestum with shallowly U shaped, very dense row of sensilla.

Aedeagus (Figs 40–42). Phallobasis considerably long, about two times longer than paramere, ventral denticle of paramere distinctly developed and situated at half of paramere length (Fig. 42).

DISTRIBUTION. Northern Thailand.

***Aphodius (Brachiaphodius) yuan sp. n.***  
(Figs 11, 43–45)

TYPE MATERIAL. Holotype (male), allotype (female) and paratypes Nos 1 and 2 (females) labelled: N. Viet Nam: Mi Lai si pan. N. Seite: Cha pa (-Sapa) 1600 m, 22°17' N, 103°44' E, prim. Urwald, 28 x -3 xi 1994, leg. Sinjaev & einb. Suminlor [p]. paratype No 3 (male) and No 4 (female) labelled: Yu. V. Yun an [- SE Yunnan] Davey shan [Mts] okr. Binbyanya [- environment of Binbyan] 1350 m, 25 VI 1956, Panfilov [igt.] [p in the Cyrillic script] / [the same but in the Chinese pictographs] [p]. paratypes Nos 5–6 (males) and Nos 7–8 (females) labelled: N. Vietnam: Prov. Lao Cai: Cat Cat nr. Sa Pa 1300–1400 m, 22°19' 43" N, 103°50' 25" E, 26 V 1999, leg. Ahrens, Tiger Fabrizio [p]. Holotype, allotype and paratype Nos 1 and 6 in DKCP, paratypes Nos 5–7 in DACD, paratype No 2 in MHNG, paratype No 8 in SMTD and paratypes Nos 3 and 4 in ZMAS.

DESCRIPTION. Body length 7.0–7.5 mm (HT 7.1 mm, AT 7.5 mm). Oblong, moderately convex. Dorsal surface absent from microreticulation, strongly shining, bearing pale, yellowish brown, recumbent setae, oriented posteriorly. Colour brown to piceous, antennae, mouthparts and extremities rather lighter coloured.

Male. Head large, almost semicircular, only very slightly convex at middle. Anterior margin of clypeus with subobsolete emargination, slightly upturned, side broadly regularly rounded, separated from gena with very shallow sinuation. Clypeal and genal margin distinctly rimmed. Gena regularly rounded, distinctly exceeding eye. Frontoclypeal and genal sutural lines distinct, tubercles entirely absent. Punctuation simple, consisting of coarse, deeply impressed, densely and almost regularly distributed punctures, separated by approximately once to twice their diameter.

Epipharynx (Fig. 11). Anterior margin laterally with weakly expressed lobes, medially straight, medial lobus absent, lateral margins approximately regularly rounded along its whole length. Only apotorma and pternotorma visibly sclerotized, epitorma and proplegmatium not distinctly bordered. Epitorma absent from medial group of setae, in distal three fourths and laterally covered with numerous microtrichiae. Anterior margin medially with dense row of long, robust setae becoming sparser laterally and confused with those of acroparia. Chaetoparia with row of 19–24 long, robust setae. Chaetopodium with short row of 5–9 long, robust setae, almost absent from microtrichiae. Acanthoparia and acroparia with numerous setae, those at acanthoparia being distinctly shorter. Apophoba and ipophoba covered with numerous thin and short setae. Nestum with shallowly U-shaped, very dense row of sensilla.

Pronotum transversal, scarcely narrowed anteriorly, anterior angle rounded, slightly projecting anteriorly, side regularly broadly rounded toward shallowly but distinctly emarginate posterior angle, basal margin slightly projecting posteriorly, with weak sinuation each side. Anterior and posterior margin absent from rim, lateral margin distinctly rimmed, except for anterior angle, rim posteriorly extended to beginning of emargination of posterior angle. Punctuation similar but rather coarser than on head. Lateral rim and basal margin with row of dense, short, posteriorly bent setae.

Scutellum triangulate, distinctly longer than wide, with several punctures

Elytron relatively long, ratio length to width of elytra combined = 1.148–1.52, widest just behind middle, humerus absent from denticle. Striae narrow, moderately deeply impressed, stria punctures distinctly crenating interval margins, regularly distributed, separated by approximately once their diameter. Striae 1 and 10 completely developed joining apically, striae 2–9 not joined posteriorly, striae 2–5 and 8–9 only very slightly shortened apically, striae 6–7 distinctly shortened, extended approximately to 0.8 of elytral length, stria 6–7 shortened before humerus, stria 8 shortened basally, extended almost to 0.3 of elytral length. Intervals almost flat, except for narrow, distinctly convex, apically angustate sutural interval, intervals 2–8 approximately of same width, punctation almost of same type as that on head.

#### Macropterous

Metasternal plate longer as wide, flat, shiny, absent from microreticulation, longitudinal line present, punctation coarse, irregular and sparse, marginally with row of dense punctures bearing long semierect setae.

All femora coarsely, densely and almost regularly punctate, each puncture bearing long semierect seta, anterior margin of profemur with distinct sharp denticle situated approximately in apical third of profemur length. Protibia long and slim, rather bent ventromedially, with three sharp, almost rectangular external teeth and with row of 13 external denticles in basal two thirds, ventromedial edge without denticles, only with row of very long, erect setae, terminal spur shortened, plump, longer than wide, apically truncate, medioapically pointed. Apical margin and two well expressed transversal carinae of meso- and metatibia fimbriate with setae strongly unequal in length. Basimesotarsomere distinctly longer than superior terminal spur, inferior terminal spur absent. Basimetatarsomere scarcely longer than superior terminal spur and distinctly longer than next three tarsomeres combined. Claws moderately curved.

Ventrites nearly alutaceous, finely shagreened, setaceous, setae double in size, consisting of dense shorter, recumbent setae and transversal row of several long regularly distributed setae.

Aedeagus (Figs 43–45). Phallobasis not considerably long, only about 1.5 times longer than paramere, paramere absent from ventral denticle.

Female differs from male by the following characters: profemoral denticle weakly developed, protibia shorter and wider, not distinctly bent ventromedially, with slim and apically pointed terminal spur, inferior terminal spur of mesotibia present, reaching approximately to half of basimesotarsomere.

**DIFFERENTIAL DIAGNOSIS.** *Aphodius (Brachiaphodius) yuan* sp. n. is habitually most similar to *A. (B.) taiwanicus*. Both species exert the following identical diagnostic characters: dorsal surface absent from microreticulation, elytron long, gena distinctly exceeding eye laterally, dorsal surface of head and pronotum finely and densely punctate, basimetatarsomere hardly longer than superior terminal spur, but the new species differs from *A. (B.) taiwanicus* in having posterior pronotal emargination absent from rim and aedeagus of obviously different shape (Figs 43–45). For differentiation from other species studied see the key below.

**NAML DERIVATION.** “Yuan Jiang” is the Chinese name of the Red River running through the distribution area of the new species, noun in apposition.

#### Key to the *Brachiaphodius* species known from the Palaearctic and the Oriental regions

- 1 (8) Dorsal surface (in some specimens only elytron) microreticulate.
- 2 (3) Elytral stria 8 only inconspicuously shortened basally. Punctation of dorsal surface sparse: punctures separated by more than 2 their diameters. Gena in male almost rectangular. Japan.  
*A. (B.) eccoptus* Bates

- 3 (2) Elytral stria 8 distinctly shortened basally, extended approximately to 0.7 of elytral length. Punctuation of dorsal surface denser, punctures separated in most cases by at most 2 their diameters. Gena in both sexes rounded.
- 4 (5) Elytron distinctly short, ratio length to width of elytra combined = 1 : 1.25. Elytral humerus finely denticulate in dorsal aspect. Basimetatarsomere distinctly longer than next three tarsomeres combined. Nepal. *A. (B.) ahrensi* sp. n.
- 5 (4) Elytron longer, ratio length to width of elytra combined = 1 : 1.46–1.55. Elytral humerus absent from denticle. Basimetatarsomere approximately equal to next three tarsomeres combined.
- 6 (7) Elytral interval 2 and 4 wider discally than interval 3. Terminal protibial spur in male approximately as wide as long (Fig. 48). Phallobasis nearly three times longer than paramere, paramere in lateral aspect curved ventrally (Fig. 24). China: Yunnan, NE Myanmar. *A. (B.) jendeki* sp. n.
- 7 (6) Elytral interval 2–4 discally of approximately the same width. Terminal protibial spur in male wider than long (Fig. 49). Phallobasis almost four times longer than paramere, paramere in lateral aspect apically straight (Fig. 33). Himalaya from Uttar Pradesh to Bhutan. *A. (B.) pilosus* Harold.
- (8) 1 Dorsal surface absent from microreticulation.
- 9 (12) Elytron short, ratio length to width of elytra combined = 1 : 1.23–1.32.
- 10 (11) Emargination of posterior pronotal angle rimmed throughout. China: Yunnan, N Thailand. *A. (B.) runpbai* Masumoto.
- 11 (10) Only distal half of posterior pronotal angle rimmed. India: Meghalaya, Uttar Pradesh, Nepal. *A. (B.) nainiensis* Petrovitz.
- 12 (9) Elytron long, ratio length to width of elytra combined = 1 : 1.42–1.52.
- 13 (18) Elytral humerus absent from denticle.
- 14 (15) Gena only inconspicuously exceeding eye (Fig. 46). Dorsal surface of head and pronotum coarsely and sparsely punctate. Basimetatarsomere considerably longer than superior terminal spur, extended approximately to 0.7 of length of basimetatarsomere. China: Sichuan. *A. (B.) babuti* Balthasar.
- 15 (14) Gena weakly but distinctly exceeding eye (Fig. 47). Dorsal surface of head and pronotum relatively finely and densely punctate. Basimetatarsomere hardly longer than superior terminal spur.
- 16 (17) Emargination of posterior pronotal angle rimmed in distal half. Aedeagus long, phallobasis considerably longer than paramere, paramere ventrally with fine denticle (Fig. 36). Taiwan. *A. (B.) taiwanensis* Petrovitz.
- 17 (16) Emargination of posterior pronotal angle absent from rim. Aedeagus short, phallobasis hardly longer than paramere, paramere ventrally absent from denticle (Fig. 45). China: Yunnan, N Vietnam. *A. (B.) yuan* sp. n.
- (18) 13 Elytral humerus in dorsal aspect finely denticulate (very rarely in some females of *A. (B.) pilifer* and *A. (B.) weibao* sp. n. denticle subobsolete).
- 19 (20) Terminal spur of protibia plump, approximately as wide as long. Paramere ventrally absent from denticle (Fig. 30). Laos, Myanmar, Vietnam. *A. (B.) pilifer* Paulian.
- 20 (19) Terminal spur of protibia in male plump, distinctly longer than wide. Paramere ventrally with denticle (Figs 39, 42).
- 21 (22) Punctuation of pronotum consisting of almost regularly spaced, punctures finer and denser, separated by approximately once their diameter, rarely by 1.5 their diameter. Denticle of ventral side of paramere less developed and situated slightly before half of paramere length (Fig. 39). China: Yunnan. *A. (B.) weibao* sp. n.
- 22 (21) Punctuation of pronotum more irregular, punctures coarser and sparser, separated in most cases by approximately twice their diameter. Ventral denticle of paramere considerably developed and situated at half of paramere length (Fig. 42). N Thailand. *A. (B.) yaunintnoi* Masumoto.

## DISCUSSION

Representatives of the subgenus *Brachnaphodius* known from the Palaearctic and Oriental regions exert very similar external morphology including aedeagus and epipharyngeal structures. The subgenus belongs to a group of subgenera sharing the following synapomorphies: dorsal surface entirely setaceous, anterior clypeal angles rounded, head absent from tubercles, pronotum with distinctly emarginate posterior angle, anterior and posterior pronotal margin absent from rim, scutellum small and triangulate, apical margin of meso- and metatibia with unequal setation (cf. Balthasar 1964: 21–24). At closer examination, all *Brachnaphodius* species studied turn out to possess the



following characters being autapomorphic within the frame of all so far known *Aphodius* subgenera: (1) profemur in both sexes anteriorly with distinct denticle (Figs 50, 51), (2) mesotibia in male absent from inferior terminal spur, (3) phallobasis laterally flattened and absent from ventral longitudinal membranous strip. Both the synapomorphic and autapomorphic characters mentioned above suggest that the *Brachiaphodius* species form a monophyletic unit that might be found to have fully generic status. On the other hand the subgenus *Brachiaphodius* seems to be closely related to the subgenus *Sinaphodius* and it differs from *Bachiaphodius* in the following characters: (1) profemur with only sharp transversal edge, (2) inferior terminal spur of mesotibia present, but shortened, (3) longitudinal membranous strip of phallobasis present. Epipharyngeal structures in *Sinaphodius* (Fig. 12) are very similar to those in *Brachiaphodius* (Figs 1–11). It is obvious that only a comprehensive taxonomic study of both preimaginal and imaginal morphology of all the *Aphodius* s.l. taxa at generic taxonomic level (genera, subgenera) or only species groups is necessary for this re-evaluation (cf. also Stebnicka & Howden 1995, Vitner 1996). In addition, three described afro-tropical species were not studied by the author.

The subgenus *Brachiaphodius* currently includes twelve described species from the area of interest (Fig. 52). The transition zone between the Palaearctic and the Oriental regions, namely central and eastern parts of the Himalayas (3 species) and south-western China with adjacent mountainous areas of Burma, Thailand, Laos and Vietnam (6 species), where they occur in natural and semi-natural habitats of high-mountainous rainforests, seems to be a centre of the distribution of this subgenus. According to the author's recent knowledge, all so far known species are not specialized dung feeders. They were taken mostly from horse, sheep or cattle dung, or from human faeces and they are probably closely tied with forest habitats.

In the latter area, where the representatives of this subgenus inhabit the highest parts of mountain ranges (about 1500–3000 m), the distribution areas of particular species are probably separated by deep valleys of great rivers Salween (Nu Jiang), Mekong (Lancang Jiang) and Yangtze (Jinsha Jiang). Here the rivers probably form clear barriers oriented almost from north to south. This also holds for several species of the subgenus studied: *Aphodius* (*Brachiaphodius*) *jendeki* sp. n. is known from the area to the west of the Salween river, *A. (B.) ruubpai* and *A. (B.) yauumtnoi* from the area between the Salween and Mekong rivers, and *A. (B.) weibao* and *A. (B.) yuan* sp. n. from the area between the rivers Mekong and Yangtze. Distribution areas of these species seem to be strongly vicariant. On the other hand *A. (B.) pilifer* described from N Vietnam (Hoa Binh) has been also recorded from Burma and doubtfully from West Bengal (for details see distribution of this species). However, *A. (B.) pilifer* is more or less tied with forest areas at lower altitudes.

Another distribution pattern is manifested in the Himalayas and on the western border of the Sichuan lowlands (eastern foot of the Tibetan plateau) where the prominent isolating barriers formed by great rivers are missing. Except for *A. (B.) ahrensi* sp. n. known as a single specimen, the other two species are distributed through the Himalayas from the Uttar Pradesh province (west limit) to Bhutan and the Meghalaya province (east limit) but they exhibit rather different altitude requirements. *A. (B.) pilosus* is a common widespread species throughout the area mentioned at altitudes of 150 to 3800 m a.s.l. (Stebnicka 1986, 1990a, Ahrens & Stebnicka 1997 and the present paper) while *A. (A.) namienensis* is known from several isolated localities situated only at a relatively lower altitude (Uttar Pradesh 600–1600 m a.s.l., Nepal Anapurna 800–1100 a.s.l. and Meghalaya 1100 m a.s.l. Stebnicka (1989), Ahrens & Stebnicka (1997) and the present paper). Unfortunately, from the easternmost part of the Himalayas, the Arunachal Pradesh province, we have had so far no record of any *Brachiaphodius* species. Only one species, *A. (B.) babori*, is hitherto known from the second area mentioned (western border of the Sichuan lowland) despite of relatively more intensive entomological investigations of this area during the last years. *A. (B.) babori* inhabit forest areas at relatively lower altitudes (900–1800 m).



Distribution areas of two other described species are completely isolated. *A. (B.) eccoptus* is known only from Japan (mountainous areas of the Honshu island) and *A. (B.) taiwanicus*, very similar to *A. (B.) babort*, is recorded from Taiwan only. There is a gap of several thousands kilometers between these two insular species and the continental *Brachiaphodius* representatives. Nevertheless this area having no representatives of *Brachiaphodius* remains almost untouched in terms of dung beetles and natural forested areas as original habitats of *Brachiaphodius* are nearly destroyed by human activity there. On the other hand, it is necessary to state that there is no *Brachiaphodius* specimen in the numerous and very rich material from the Fujian province collected by J. Klapperich in 1938 and by Tschung Sen in 1946 (MHNG) even though both collectors had a possibility to collect them through whole the season there.

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## Early Miocene pratincoles (Aves: Glareolidae) from Dolnice, Czech Republic

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**Abstract.** Two species of pratincoles were recorded from the early Miocene of Dolnice in western Czech Republic, incl. *Mioglareola dolnicensis* (Švec, 1980) and *M. gregaria* Ballmann, 1979. They represent the oldest record of the Glareolidae in the Old World. The remaining Tertiary record of the family Glareolidae is limited to the early Miocene of Nebraska and the middle Miocene of Germany. *Larus dolnicensis* Švec, 1980 was transferred from the Laridae to the Glareolidae.

**Taxonomy, paleontology, Aves, Glareolidae, *Larus dolnicensis*, Miocene**

### INTRODUCTION

The pratincoles and coursers (family Glareolidae) are a peculiar group of charadriiform birds, that inhabit subtropical and tropical wetlands of the Old World (Johnsgard 1981, Hayman et al. 1986). The fossil record of this family is extremely scarce, being limited to the early Miocene of Nebraska (Olson & Steadman 1979) and the middle Miocene of Germany (Ballmann 1979) so far.

In the present paper, bone remains of pratincoles from the early Miocene deposits of Dolnice in western Bohemia are described. The Dolnice locality consists of lake sediments, belonging to the MN-zone 4b (sensu Mein 1990). It lays in the Cheb County, western Bohemia, Czech Republic. For details on the locality see Fejfar & Roček (1988), Fejfar (1990), Mlíkovský (1992, 1996a), and Fejfar & Kvaček (1993). The material is deposited in the collections of Oldřich Fejfar in Praha, and in the Department of Paleontology of the Charles University in Praha (DP FNSP). The classification of the Charadriiformes follows Strauch (1976).

The skeletons of modern birds were examined in the United States National Museum in Washington, D. C., in the Paleontological Institute of the Russian Academy of Sciences in Moskva, and in the author's collection in Praha.

Order Charadriiformes Huxley, 1867

Family Glareolidae Brehm, 1831

Genus *Mioglareola* Ballmann, 1979

***Mioglareola gregaria* Ballmann, 1979**

*Mioglareola gregaria* Ballmann, 1979: 68, text-fig. 3, pl. 1, fig. 3–5.

**MATERIAL.** Cranial fragment of left coracoid, distal part of left carpometacarpus; in coll. O. Fejfar (Praha), unatalogued.

**MEASUREMENTS.** Coracoid: distance between the foramen nervi supracoracoidei and proximal end of processus acrocoracoideus = 7.4 mm; carpometacarpus: distal width = 3.7 mm.

REMARKS These two elements agree both in morphology and in size with *Mioglareola gregaria* from the middle Miocene (MN 6) of Steinberg in Germany (see Ballmann 1979 for relevant data). This is the earliest record for the species.

***Mioglareola dolnicensis* (Švec, 1980) comb. n.**

*Larus dolnicensis* Švec 1980: 380, pl. 1, fig. 2 (partim) 3.

MATERIAL: Distal part of left humerus (holotype), DP FNSP 7344.

MEASUREMENTS: Distal width = 8.5 mm. See Švec (1980: 380) for further measurements.

REMARKS: Švec (1980) described this species as a gull, although he compared it, inexplicably, only with *Scelopax* Linnaeus, 1758 and *Gallinago* Brisson, 1760 in the diagnosis. Olson (1985: 182) pointed out that the holotype humerus fragment appears to lack the deep fossa musculi brachialis characteristic of *Larus*. My reexamination of the holotype confirmed Olson's suspicion. In fact, the specimen does not resemble larid humeri at all and is clearly referable to the Glareolidae. In particular, it differs from the humeri of the Laridae and agrees with those of the Glareolidae in having (1) distal end relatively broad, (2) fossa musculi brachialis less deep, and (3) processus supracoracoideus dorsalis less inclined palmarly.

Within this family, it the holotypical humerus of *Larus dolnicensis* agrees with the same elements of *Mioglareola* and differs from that of other glareolids in having (1) processus supracondylaris dorsalis relatively large, (2) fossa musculi brachialis shallow, and (3) scar for attachment of ligamentum collaterale ventrale on the tuberculum supracondylare ventrale extended proximally. *Mioglareola dolnicensis* was larger than *M. gregaria*, described from the middle Miocene (MN 6) of Nordlinger Ries in Germany (Ballmann 1979) and known from Dolnice as well (see above). Distal width of its humeri is ca. 6.0–6.5 mm (Ballmann 1979), which corresponds with the value for the largest modern pratincole, *Glareola pratincola* (Linnaeus, 1766), while the same value is 8.5 mm in *Mioglareola dolnicensis*. In fact, *M. dolnicensis* was the largest pratincole ever known. Although I was not able to detect any morphological differences between the humeri of *M. gregaria* and *Mioglareola dolnicensis*, the size difference is sufficient to maintain the separate specific status for the Dolnice pratincole.

FOSSIL RECORD OF THE GLAREOLIDAE

Three species, tentatively included in the Glareolidae, were described from the early Eocene deposits of England, incl. *Precursor parvus* Harrison & Walker, 1977, *P. magnus* Harrison & Walker, 1977, and *P. litorinum* Harrison & Walker, 1977. Until restudied, these species cannot be accepted as an evidence for the existence of the family in the British Eocene (see Steadman 1981, cf. also Mlikovsky 1996b,c).

The family Glareolidae is currently limited to the Old World (Johnsgard 1981, Hayman et al. 1986). In spite of that, the oldest reliable record of the family comes from North America, where *Paractornis perpusillus* Wetmore, 1930 is known from the early Miocene (MN 3) of Carnegie Hill in Nebraska (Olson & Steadman 1979).

In the Old World, the record is limited to the early and middle Miocene. An extinct genus, *Mioglareola*, was recorded from the early Miocene (MN 4b) of Dolnice in the Czech Republic (this paper), and from the middle Miocene (MN 6) of Steinberg in Germany (Ballmann 1979). Two species were recorded in Dolnice, incl. *Mioglareola gregaria*, and *M. dolnicensis* (Švec, 1980), while only

the former species was found in Steinberg. The record is furnished with *Glareola neogena* Ballmann, 1979 from Steinberg and Goldberg (MN 6) in Germany. The latter species is the oldest record of the modern genus *Glareola*.

In addition, a damaged fragment of a coracoid from the late Miocene (MN 13) of Polgardi in Hungary was tentatively referred to as "*Cursorius* sp." by Jánossy (1991). The specimen was neither figured, nor described, and the author himself commented that 'the fragment enables no further conclusions' (Jánossy 1991: 25). Accordingly, I am not willing to accept this as an evidence for the existence of the Glareolidae, or even of the genus *Cursorius* Latham, 1790 in the late Miocene of Hungary.

Summarizing this scanty evidence, it is clear that the Glareolidae inhabited both New and Old World in the early Miocene, although the date of their disappearance from the New World remains unknown, the only record being dated to MN 3. The reliable Old World record is limited to the zones MN 4–6 of Central Europe (see also Mlíkovský 1996c).

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## Chinese species of the genus *Leiodes* (Coleoptera: Leiodidae: Leiodinae)

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**Abstract.** *Leiodes mirkae* sp. n., *L. parallela* sp. n., *L. puetzi* sp. n., *L. schneideri* sp. n., *L. schuelkei* sp. n., *L. semipunctata* sp. n. and *L. sichuanica* sp. n. from China are described. All known Chinese species of the genus *Leiodes* Latreille, 1802 are keyed. New records for *L. lucens* (Fairmaire, 1855) for Yunnan and *L. nitidodini* Švec, 1991 for Sichuan are given. Geographical distribution of Palearctic *Leiodes* species from Asia is indicated.

**Taxonomy, descriptions, key, distribution, Leiodidae, *Leiodes*, China**

### INTRODUCTION

Most of the known Chinese species of *Leiodes* Latreille, 1796 were reported or described recently (Angelini & Švec 1994, Švec 1991). Now through the kindness of Alexander Pütz (Eisenhüttens-tadt), Miroslav Janata (Praha), Jan Schneider (Praha), Jaroslav Turna (Kostelec na Hané), Aleš Smetana (Ottawa), Jan Farkač (Praha), Jan Růžička (Praha) and Wolfgang Schawaller (Stuttgart) I have had the opportunity to study interesting material comprising 10 species (53 specimens) from China which represent 7 species new for science. New faunistics records are given.

The material studied was compared with the specimens including the types of Chinese species deposited in the collection of the author.

The specimens mentioned in the paper are deposited in the collection of the Staatliches Museum für Naturkunde, Stuttgart (SMNC), Švec's collection (SC), Schülke's collection (SCHC), Smetana's collection (SMC), Schneider's collection (SCHNC), Růžička's collection (RC) and Pütz's collection (PC).

The length of body given in the key and in the descriptions is taken from the type specimens, other measurements and ratios are taken from the holotypes only. The measurements were approximated to the nearest 1st decimal place, the ratios were reckoned from the unapproximated numbers. Ratios of length, width and width : length of antennal segments are not quite constant as to exact numbers. The ratios given in the following descriptions mean only that a segment is longer, shorter, wider etc. than the other one. Types of mesosternal carina indicated in this work following descriptions according to Daffner (1983). The author's remarks are given in square brackets near locality data.

### TAXONOMIC PART

Until now 13 species from continental China and 1 species from Taiwan were known. Seven species new to science are added here.

# Key to the Chinese species of the genus *Leiodes*

(number in round brackets indicates the point of the last step in the key)

- 1 Mesosternum with low not raised carina (Figs 1, 2) 2  
Mesosternum with high raised carina (Fig. 3) 20
- 2 (1) Ninth elytral row of punctures well separated from lateral margin at shoulder, oblique or parallel to lateral margin, joining lateral channel at about basal third of elytral length 3  
Ninth elytral row absent or consisting of several punctures at shoulder arranged closely to lateral channel 17
- 3 (2) Mesosternal carina of type A (Fig. 1) 4  
Mesosternal carina of type B (Fig. 2) 10
- 4 (3) Last antennal segment distinctly narrower than previous one. Ratio of width of antennal segments  $10^{\text{th}}/11^{\text{th}} = 1.2-1.3$  5  
Last antennal segment as wide as previous one or at most very slightly narrower than  $10^{\text{th}}$  segment. Ratio of width of antennal segments  $10^{\text{th}}/11^{\text{th}} =$  at most 1.1 6
- 5 (4) Head and pronotum distinctly strongly punctured. Punctures of elytral rows separated by about 1.0-1.5 times their diameter. Interval punctures of usual shape. Length of body 3.8 mm. China (Gansu) *L. mirhae* sp. n.  
Head and pronotum superficially finely punctured. Punctures of elytral rows separated by about 2-4 times their diameter. Elytral intervals with minute raised granules on disc of elytra. Length of body 2.9 mm. China (Sichuan) *L. sichuanica* sp. n.
- 6 (4) Pronotum strongly and densely punctured, its lateral margins slightly tapered from middle to base. Intervals of elytra with dense and fine punctures. Apex of tegmen broadly rounded. Oval. Length of body 2.5-3.8 mm. N. Africa, Europe, Afghanistan, Mongolia, China (Gansu, Xinjiang), Eastern Siberia *L. bicolor* (Schmidt, 1841)  
Pronotum finely and densely punctured, lateral margins parallel in basal half of length. Punctures of elytral intervals small and scarce 7
- 7 (6) Lateral margins of elytra nearly straight, parallel in basal half. Oblong oval. Parameres shorter than tegmen 8  
Lateral margins of elytra rounded. Oval or shortly oval. Parameres reaching beyond tip of tegmen 9
- 8 (7) Last antennal segment a little narrower than previous one. Posterior femur without tooth in male. Sides of tegmen roundly tapered to the tip distally. Length of body 2.8-4.0 mm. Siberia, Mongolia, China (Gansu), Canada *L. diluipes* (J. Sahlberg, 1903)  
Last antennal segment as wide as previous one. Posterior femur with a tooth at middle of hind margin. Sides of tegmen slightly emarginate before tip. Length of body 3.7 mm. China (Xinjiang) *L. wuzeki* Angelini et Švec, 1994
- 9 (7) Pronotum with dense distinct double puncturation. Punctures of elytral rows closely separated. Aedeagus with small bump at tip. Length of body 3.0-1.0 mm. Europe, Caucasus, E. Siberia, China (Gansu) *L. ferruginea* (Fabricius, 1787)  
Pronotum with sparse simple puncturation. Punctures of elytral rows widely separated. Aedeagus simply narrowly rounded at tip (Fig. 8). Length of body 2.3 mm. China (Shaanxi) *L. semipunctata* sp. n.
- 10 (3) Elytral intervals with punctures of two different sizes (odd intervals also with scattered larger punctures) 11  
Elytral intervals with simple puncturation (odd intervals also with scattered large punctures) 13
- 11 (10) Lateral margins of elytra distinctly rounded in dorsal view. Each paramere with 2 setae without membranous appendage. Tegmen constricted before tip. Length of body 3.4 mm. China (Sichuan) *L. alexandrae* Angelini et Švec, 1994  
Lateral margins of elytra straight to middle, parallel or slightly divergent. Each paramere with 2 setae and membranous appendage 12
- 12 (11) Pro- and mesotibia twice as wide as  $3^{\text{rd}}$  tarsal segment in male. Tegmen simply narrowed toward tip distally. Length of body 3.2-5.0 mm. Europe, Siberia, Mongolia, China (Sichuan, Yunnan) *L. lucens* (Fairmaire, 1815)  
Pro and mesotibia as wide as  $3^{\text{rd}}$  tarsal segment in male. Sides of tegmen slightly emarginate before tip (Fig. 6). Length of body 3.9-4.5 mm. China (Gansu) *L. parallela* sp. n.
- 13 (10) Last antennal segment as wide as previous one. Elytral intervals hardly visibly punctured, with very few minute punctures. Tegmen constricted before very narrowly rounded tip (Fig. 7). Length of body 3.0 mm. China (Sichuan) *L. pueri* sp. n.

- Last antennal segment narrower than previous one 14
- 14 (13) Tegmen ends in slim pointed tip (Daffner 1983: figs 290, 291) Length of body 3 mm Taiwan  
*L. klapperichi* Daffner, 1983
- Tegmen rounded at the top 15
- 15 (14) Lateral margins of elytra straight and nearly parallel in basal half of elytral length Tegmen broadly rounded at the top as in Fig. 11 Length of body 2.5–2.8 mm China (Shaanxi) *L. schuelkeri* sp. n.
- Sides of elytra rounded Tegmen shortly rounded at the tip (Two very similar species) 16
- 16 (15) Sides of terminal part of tegmen conically tapered to tip, before end slightly emarginate Parameres distinctly shorter than tegmen Length of body 3.0–3.1 mm China (Gansu)  
*L. chinensis* Angelini et Švec, 1994
- Sides of tegmen distinctly concave before end Parameres nearly as long as tegmen Length of body 2.8 mm China (Yunnan) *L. beccarii* Angelini et Švec, 1994
- 17 (2) Basal margin of pronotum distinctly emarginate before hind angles 18
- Base of pronotum before hind angles straight 19
- 18 (17) Parameres unusually broad, multisetose Length of body 4.7–5.0 mm China (Sichuan)  
*L. schneideri* sp. n.
- Parameres of usual shape, bisetose Length of body 4.2 mm China (Yunnan)  
*L. curvidens* Angelini et Švec, 1994
- 19 (17) Antennal club reddish-brown Mesosternum of type A Parameres short, reaching about middle of tegmen ending in narrowly rounded tip Length of body 4.5–6.5 mm Siberia, Mongolia, China  
*L. rufipes* (Göbler, 1833)
- Antennal club dark Mesosternum of type B Tegmen ends in small bump Length of body 2.8–3.6 mm China (Gansu, Sichuan) *L. nikodymi* Švec, 1991
- 20 (1) Pronotum finely and distinctly punctured Aedeagus widely rounded at tip Length of body 2.1–2.3 mm China (Xinjiang) *L. jurassici* Angelini et Švec, 1994
- Pronotum nearly impunctured Aedeagus narrowly rounded at tip Length of body 2.5 mm Tadzhikistan, China (Xinjiang) *L. xinjiangensis* Angelini et Švec, 1994

#### *Leiodes chinensis* Angelini et Švec, 1994

*Leiodes chinensis* Angelini et Švec, 1994: 24

ADDITIONAL MATERIAL EXAMINED: 2 spec., China, Gansu prov., Xinlong Shan Massif, Zuzhong, 35°50' N, 104°02' E, ca 2600 m [above sea level], 6 vii 1995, M. Janata lgt., 1 spec., China, Gansu prov., valley E of Ponggartang, 32°14' N, 102°55' E, 2700 m [above sea level], 9 vii 1995, M. Janata lgt., all SC, 1 spec., China, Gansu, Ponggartang, 30 v 1992, M. Bok lgt., SMNC

Investigation of the present material shows colour variability of the species. Dorsum whole chestnut or chestnut with brown head or some specimens with dark brown head and pronotum and chestnut elytra or with whole dorsum deeply dark brown in the specimens examined. Legs reddish brown to dark brown. Also strength and density of pronotal puncturation and puncturation of elytral intervals variable. This puncturation is much more distinct and denser in the material examined than in the types. Punctures of elytral rows never separated more than by about 2–4 times their diameter in this species. Known from Gansu till now (Angelini & Švec 1994)

#### *Leiodes lucens* (Fairmaire, 1855)

*Antistoma lucens* Fairmaire, 1855: 26

*Leiodes lucens* Daffner 1983: 71

*Leiodes lucens* Angelini & Švec 1994: 22

ADDITIONAL MATERIAL EXAMINED: 1 male, China, N. Yunnan, Xue Shan, near Zhongdian, 4050 m, 27°49' N, 99°34' E, 24 vi 1993, A. Smetana, J. Tarkac, P. Kabatek lgt., SMC, 1 male, China, W. Sichuan, Daxue Shan, Paoma Shan, b. Kangding, 30°02'56" N, 101°58'05" E, 2700–2900 m [above sea level], 22 v 1997, M. Seluške lgt., SCHC

Known from Sichuan in China till now (Angelini & Švec 1994). New for Yunnan

***Leiodes mirkae* sp. n.**

(Figs 1, 4, 5)

TYPE MATERIAL. Holotype: male, China, S. Gansu, Yuzhong Xinlongshan massif, 35° 50' N, 104° 02' E, ca. 2400 m [above sea level], conifer forest, stream ravine, 6 vii 1995, M. Janata leg., deposited in SC.

DESCRIPTION. Short oval. Head and pronotum dark brown, margins of pronotum lighter, scutellum black, elytra red-brown. Underside red-brown. Mouth parts red, legs and antennal segments 1 to 6 red-brown, antennal club black.

Length of body 3.8 mm, head 0.3 mm, pronotum 1.1 mm, elytra 2.4 mm, antenna 1.0 mm. Maximal width of head 1.0 mm, pronotum 1.9 mm at base, elytra 2.1 mm at base, 2.2 mm in basal third.

Head. Distinctly strongly punctured, punctures separated by 2–5 times their own diameter. Interstices without microreticulation. Four large punctures placed in transversal row before posterior level of eyes. Antenna as in Fig. 5. Ratio of length of antennal segments 2 to 11 (the 2nd equal to 1.0): 1.0–1.3 : 0.8–0.8–0.8–1.2–0.3–1.8–1.7–1.8. Ratio of width of club segments 7 to 11 (7th equal to 1.0): 1.0–0.8–1.3–1.3–1.1. Ratio of width/length of the antennal club segments: 1.5–4.0 : 1.3–1.4–1.1.

Pronotum. Pronotum widest at base, lateral margins roundly converging toward anterior angles. Posterior rectangular angles broadly rounded in dorsal view. In lateral view posterior angles blunt, very broadly rounded. Margins of pronotum roundly tapered to anterior angles, viewed laterally. Punctures strong separated by about 2–3 times their own diameter. With an irregular row of punctures before base, mainly at hind angles. Four large punctures transversally arranged in two pairs far before base, at about fifth of pronotal length (similar to those in *L. silestaca*). Also with several large punctures irregularly distributed at central part of pronotum.

Scutellum. With distinct punctures as large as those on pronotum as well as some minute punctures interposed.

Elytra. Widest at their anterior third of length. In dorsal view lateral margins visible only at shoulders. Surface without microreticulation. With regular rows of punctures. Ninth row distinctly oblique, short, joined lateral channel at proximal third of elytral length. Rows composed of strong punctures separated by 1.0–1.5 times their own diameter. Odd intervals with some larger punctures as large as those in rows. All intervals distinctly punctured, punctures separated by 2–5 times their own diameter. Punctures with tendency to form 2 irregular rows in each interval. In addition there are some much smaller punctures interposed.

Membranous wings fully developed.

Mesosternum. Carina of type A as in Fig. 1.

Metasternum and ventrites. Without striking characters.

Legs. 2nd to 4th segment of anterior tarsi and mesotarsi slightly but distinctly dilated. Anterior tibiae apically twice as wide as at base, broader than 11th antennal segment, narrower than 10th. Ratio of width of anterior tibia : 11th antennal segment = 1.0 : 0.9, the same ratio of foretibia and 10th segment = 1.0 : 1.1. Posterior femora simply shaped, very slightly lobed at ventral margin at apex. Hind tibiae missing in holotype.

Genitalia. Aedeagus as in Fig. 4.

BIONOMY. Not known.

DERIVATIO NOMINIS. Following to the wishes of the collector, the new species is dedicated to his daughter Mirka.

DIFFERENTIAL DIAGNOSIS. *L. mirkae* sp. n. could be compared to *L. silestaca* (Kraatz, 1852) by the same type of mesosternum, large shortly oval body, short antennae, by last antennal segment narrower than the previous one and by the presence of large punctures before base of pronotum.

*L. mirkae* sp. n. differs from this species by the interval punctures tending to form irregular rows, not so in *L. silesiaca*. Also the new species differs from *L. silesiaca* by distinctly narrower anterior tibiae; the aedeagus and endophallus are of different shape (aedeagus of *L. silesiaca* was figured by Daffner 1983: figs 121, 122).

### *Leiodes nikodymi* Švec, 1991

*Leiodes nikodymi* Švec, 1991: 378.

ADDITIONAL MATERIAL EXAMINED. 16 spec., China Gansu, Xinlongshan b., Yuzhong, Yangzhai, 3000 m [above sea level], 7.–9.viii.1994, Heinz lgt. (12 spec. SMNC, 4 spec. SC); 2 spec., China, Gansu, pass ca 46 km W Linxia, Dalijia Shan, 10.–11.vi.1994, Heinz lgt. (SMNC); 3 spec., China, W Sichuan, road Kangding – Xinduqiao, pass 16 km W Kangding, 4,290 m [above sea level], alpin region, J. Turna lgt. (SC); 1 spec., China, NW Sichuan, 32° 30' N, 98° 25' E, pass 20 km S Qagea, 4,100 m [above sea level], alpine meadow, 17.–18.vii.1995, J. Turna lgt. (SC).

Variability of the specimens examined: Body length 2.8–3.6 mm, colour of dorsum from red to black with brown femora and tibiae, pronotal base and tarsi reddish. Antennal club red. Most of the specimens examined with trace of 9th elytral row consisting of several punctures placed near to elytral margin. Known from Gansu in China till now (Angelini & Švec 1994). New for Sichuan.

### *Leiodes parallela* sp. n.

(Figs 2, 6)

TYPE MATERIAL. Holotype, male, China, Gansu, Ponggartang, 30.vi.1992, M. Bok lgt.; paratypes, 2 female, the same. Holotype and 1 paratype deposited in SMNC, 1 paratype in SC.

DESCRIPTION. Very oblong oval, black-brown, clypeus and basal margin of pronotum red-brown, mouth parts, tibiae, tarsi and 1st to 6th antennal segments red, antennal club slightly infuscate. Head, pronotum and scutellum black, basal margin of pronotum red-brown, elytra brown in one of paratypes. Underside black-brown, abdomen black, femora and tip of mandibles brown.

Length of body 3.9–4.5 mm, in holotype 4.1 mm, head 0.4 mm, pronotum 1.1 mm, elytra 2.6 mm, antenna 1.1 mm. Maximum width of head 1.0 mm, pronotum 1.8 mm at base, elytra 1.9 mm at base, 2.0 mm at middle.

Head. Temples with oblique microsculpture, rest of head apart from puncturation smooth. Punctures of 3 various sizes; largest punctures very densely arranged separated by 0.5–1.0 times their diameter, some smaller punctures of two sizes interposed. Four punctures larger than others placed in transverse row before posterior level of eyes. Ratio of length of antennal segments 2 to 11 (the 2nd equal to 1.0): 1.0–1.3–0.9–0.9–0.6–1.1–0.4–1.2–1.2–1.7. Ratio of width of club segments 7 to 11 (7th equal to 1.0): 1.0–0.8–1.4–1.4–1.2. Ratio of width : length of the antennal club segments: 1.2–2.5–1.5–1.5–0.9.

Pronotum. Widest at base, lateral margins parallel at basal third, then rounded toward anterior angles. Base straight. Posterior angles rectangular very closely rounded, in dorsal view. In lateral view, posterior angles blunt, closely rounded, lateral margins of pronotum rounded, before hind angles slightly concave in lateral view. Puncturation sparser than that of head, punctures of two various sizes, the larger punctures separated by about 2–3 times their own diameter, with small scattered impunctured areas; some very small, minute punctures interposed. Without microsculpture between punctures. Just before base with irregular row of large punctures. With several equally large punctures behind the anterior margin.

Scutellum. Without microreticulation, at basal two thirds punctured as on pronotum, apex with several punctures.



Elytra. Lateral sides straight from base to middle, slightly divergent, then curved to apex. Lateral margins of elytra dorsally visible in male and visible just behind shoulders and then from middle to apex in female. With regular rows of punctures. Short 9th row distant from lateral margin, parallel with it, joined lateral channel near behind basal third of elytral length. This row slightly oblique in one of the paratypes. Elytral rows composed of strong punctures separated by their diameters. Surface without microreticulation, intervals with double puncturation, the larger punctures separated by about 2–4 times their own diameter. Numerous small punctures interposed. Odd intervals with some punctures as large as those in rows.

Membranous wings fully developed.

Mesosternum. Carina of type B ending vertically as in Fig. 2.

Metasternum. Oval plane bordered by coarse punctures bearing long recumbent setae. Sides of metasternum with shallow, irregularly distributed punctures. Surface microreticulate.

Ventrites. Without striking characters.

Legs. In male 2nd to 4th segment of anterior tarsi and mesotarsi heart shaped, strikingly dilated. Third segment as wide as tibiae at apex, 4th one slightly narrower. Anterior tibiae nearly twice as broad as width of 11th antennal segment in male. In female tarsi simple, anterior tibiae a little broader than width of last antennal segment. Posterior femora with blunt angle at hind margin in distal third, slightly lobe shaped dilated just before apex in male. Hind tibiae slightly simply curved in male. In female femora without striking characters, hind tibiae very slightly simply curved.

Genitalia. Aedeagus as in Fig. 6.

BIONOMY. Not known.

DERIVATIO NOMINIS. It is derived from the parallel shape of body.

DIFFERENTIAL DIAGNOSIS. *L. parallela* sp. n. is similar to *L. lucens* by the type of mesosternum, last antennal segment narrower than the 10th and by the type of surface puncturation. It differs by its very oblong oval parallel shape of body, by extremely dilated anterior and middle tarsi in male. Aedeagus and shape of endophallic structures are similar but show clear difference (aedeagus of *L. lucens* was figured by Daffner 1983: figs 221, 222).

#### *Leiodes puetzi* sp. n.

(Fig. 8)

TYPE MATERIAL. Holotype: male, China, Sichuan, Daxue Shan, Gongga Shan Mts, Hailougou Glacier Park, 29°36' N, 102°04' E, river valley ca 1 km above Camp 1, 2100 m [above sea level], 28–31 v 1997. A. Putz lgt. paratypes: 1 male, 1 female, China, Sichuan, Daxue Shan, Gongga Shan Mts, Hailougou Glacier Park, 29°36'00" N, 102°03'35" E, Camp 1, 27–31 v 1997. M. Schulke lgt. Holotype deposited in PC, female paratype in SCHC, male paratype in SC.

DESCRIPTION. Body shortly oval. Chestnut to dark brown coloured, pronotal and elytral margins lighter, mouth parts, antennal segments 1 to 6, and legs red-brown, antennal club infuscate or segments 7–9–11 black with 8th antennal segment infuscate. Underside yellow-brown.

Length of body 2.8–3.0 mm, in holotype 3.0 mm, head 0.4 mm, pronotum 0.7 mm, elytra 1.9 mm, antenna 0.9 mm. Maximal width of head 0.8 mm, pronotum 1.5 mm at base, elytra 1.7 mm in basal third.

Head. With slightly developed microreticulation. Punctures distinct strong, separated by 2–3 times their own diameter. Small area at vertex without any puncturation. Four large punctures placed in transverse row before posterior level of eyes. Closely to internal margin of each eye with 3 large setae bearing punctures clearly visible laterally. Ratio of length of antennal segments 2 to 11 (the 2nd equal to 1.0) in holotype: 1.0–1.6–0.7–0.7–0.7–0.9–0.5–1.2–1.0–1.5. Ratio of width



of club segments 7 to 11 (7th equal to 1.0): 1.0–0.7–1.4–1.3–1.3. Ratio of width : length of the antennal club segments: 1.2–1.6–1.3–1.5–0.9.

Pronotum. Widest at base, lateral margins to middle conically tapered, then roundly narrowed to anterior angles. Base straight. Posterior angles sharp, widely rounded, in dorsal view. In lateral view, posterior angles rather blunt, widely rounded, lateral margins of pronotum very slightly rounded, nearly straight in basal third, before hind angles slightly concave, from first third of their length roundly tapered to anterior angles viewed laterally. Surface reticulation as on head. Punctures sparser and much finer than on head, irregularly distributed, separated by about 3–6 times their own diameter. Just before base with irregular row of large punctures.

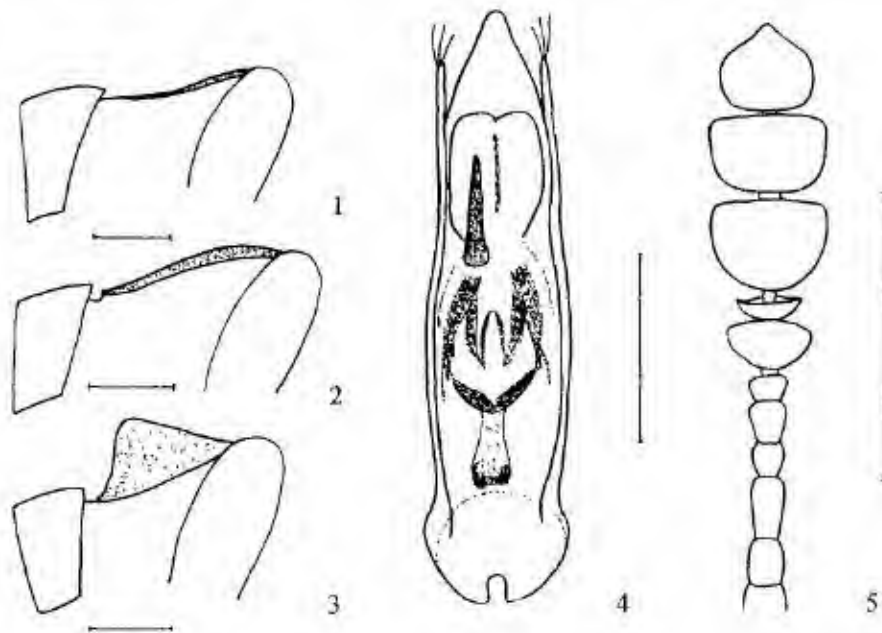
Scutellum. With traces of microreticulation, puncturation similar to that of head.

Elytra. Sides rounded. Lateral margins of elytra visible for entire length in both sexes. With regular rows of punctures. Short oblique 9th row clearly separated from lateral margin, joined to lateral channel just behind basal third of elytra. Elytral rows composed of small but distinct punctures separated by about twice their own diameter. Surface without microreticulation. Puncturation of intervals indistinct, sparse and very scattered consisting of fine very minute punctures. Odd intervals with some large punctures a little smaller as those of stria rows.

Membranous wings fully developed.

Mesosternum. Carina of type B.

Metasternum. Surface microreticulate. Oval central plane covered by fine punctures bearing long recumbent setae. Sides of metasternum with shallow irregularly distributed punctures.



Figs 1–5. 1–3: shape of mesosternal carina; 1 – *Letodes murkai* sp. n. – type A, 2 – *L. parallela* sp. n. – type B, 3 – *L. xingjiangensis* Angelini et Švec, 1994. 4–5: *L. murkai* sp. n., 4 – aedeagus dorsally, 5 – antenna. Scale in Figs 1–3 = 0.1 mm, in Figs 4–5 = 0.5 mm.

Ventrites Without striking characters

Legs Segments 1–4 of anterior tarsi and mesotarsi slightly dilated in male. Anterior tibiae about as broad as 11th antennal segment in male. Posterior femora with very small narrow lobe just before end, hind tibiae slightly simply curved in male. Tarsi and femora simple, hind tibiae nearly straight in female.

Genitalia Aedeagus as in Fig. 8

BIONOMY Not known

DERIVATIO NOMINIS Named after Alexander Putz, one of the collectors

DIFFERENTIAL DIAGNOSIS *L. putzi* sp. n. is similar to *L. chinensis* Angelini et Švec, 1994 and to *L. becvarti* Angelini et Švec, 1994 in the form of mesosternal carina, by the rounded sides of elytra, the finely punctured pronotum, and by the small widely spaced punctures of elytral rows. It differs in last antennal segment, which is as wide as the previous one, while in *L. chinensis* and *L. becvarti* the same antennal segment is narrower than the 10th. *L. putzi* sp. n. differs also by the multisetose parameres while parameres in both species compared are bisetose.

***Leiodes schneideri* sp. n.**

(Figs 70, 14, 15)

TYPE MATERIAL. Holotype, male: China, W Sichuan, 20 km N Sabdê, 3200 m [above sea level], 29° 35' N, 101° 23' E, 10–16 VII 1998, J. Schneider leg. 1998 China expedition, J. Farkaš, D. Kral, J. Schneider & A. Smetana. Paratypes: 5 males: the same data; paratypes: 3 males, 1 female, the same data. J. Farkaš leg. paratypes: 1 male, 1 female: the same data. D. Kral leg. paratype: 1 female, China, W Sichuan 2000–3500 m [above sea level]. Mts ca 20 km NNW Sabdê, 18–20 VI 1994. J. Kalab leg. Holotype, 7 male and 2 female paratypes deposited in SC. 1 male and 1 female paratype in RC. 1 male paratype in SCHNC.

DESCRIPTION. Body oblong oval in male, short oval in female. Body shape of holotype as in Fig. 14. Whole dorsum black brown except of red-brown narrow strip at pronotal base, tip of mandibles and antennal club brown to black, in some specimens only distal parts of antennal club segments infuscate, mouth parts, antennal segments 1st to 6th and protarsi red, meso- and metatarsi and tibiae red-brown. One paratype a little lighter coloured with red-brown margins of pronotum. Underside red-brown, femora, coxae and trochanters darker.

Length of body 4.3–5.0 mm, in holotype 5.0 mm, head 0.8 mm, pronotum 1.1 mm, elytra 3.1 mm, antenna 1.4 mm. Maximum width of head 1.3 mm, pronotum 2.4 mm at base, elytra 2.4 mm at base, 2.6 mm at basal third of elytral length.

Head. Very coarsely and densely punctured, punctures separated by about 1.0–1.5 times their diameter. Some minute punctures interposed. Interstices smooth. Four larger punctures placed in irregular transverse row before posterior level of eyes. Ratio of length of antennal segments 2 to 11 (the 2nd equal to 1.0) = 1.0–1.2–0.8–0.8–0.7–1.2–0.5–1.4–1.3–1.6. Ratio of width of club segments 7 to 11 (7th equal to 1.0) = 1.0–0.8–1.3–1.4–1.1. Ratio of width: length of the antennal club segments = 1.4–2.3–1.5–1.7–1.1. Antenna in holotype as in Fig. 15.

Pronotum. Widest at base, lateral margins rounded toward anterior angles. Base very distinctly emarginate before hind angles in male, slightly in female. Sharp posterior angles closely rounded in dorsal view. In lateral view, posterior angles blunt, closely rounded, lateral margins of pronotum slightly concave at basal half, from middle nearly straightly narrowed to anterior angles. Punctuation a little finer and sparser than on head. Punctures of two various sizes, the larger separated by about 2 their own diameter, some smaller punctures irregularly interposed separated by about 2–6 times their diameters. Beside them just before base with many large punctures. Interstices without microsculpture.

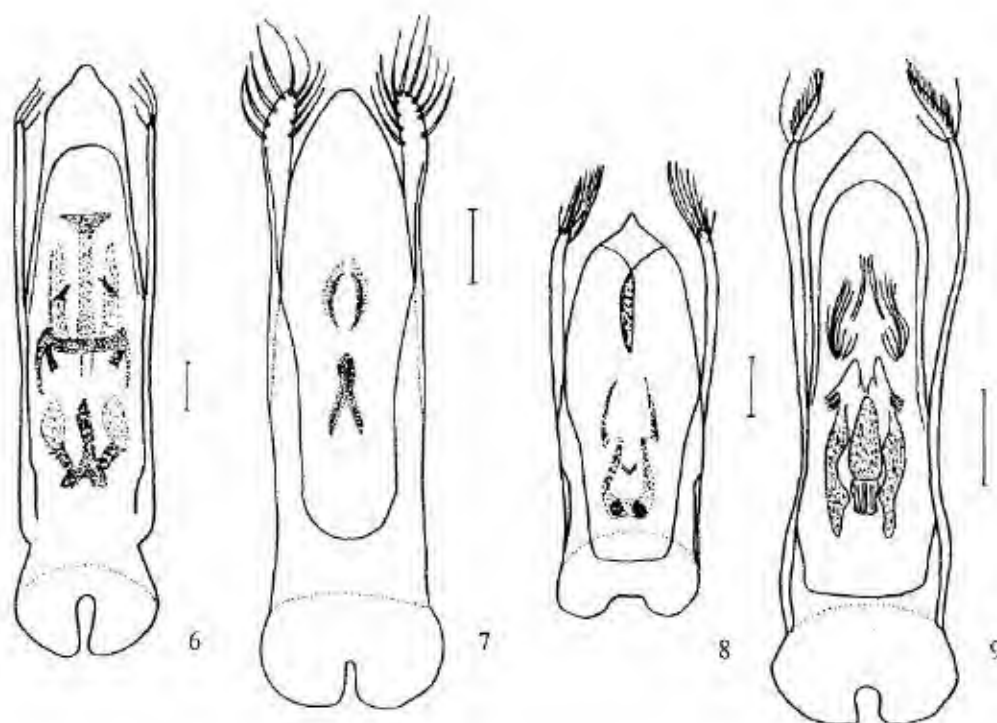
Scutellum. With microreticulation, puncturation similar to that of pronotum, some smaller punctures interposed.

Elytra. Widest in basal third, sides rounded. In dorsal view lateral margins of elytra visible from shoulders within whole their length. With regular rows of punctures. Trace of 9th double row consisting of several punctures runs closely parallel to lateral margin, ending near basal quarter. Elytral rows composed of strong punctures separated by 0.5 – 1.0 times their diameter. Surface with slight microreticulation, intervals with small punctures separated by about 2 – 3 times their diameters, some smaller ones irregularly interposed. Odd intervals with some punctures as large as those in rows.

Membranous wings fully developed.

Mesososternum. Type A according to Daffner (1983).

Metasternum. Surface microreticulate. Oval central plane situated at posterior half of metasternal length bordered by dense punctures separated by 1 – 2 times their own diameter. Sides of metasternum with shallow irregularly distributed large punctures. Metasternum with large shallow foveae postero-medially in female.



Figs 6–9. Aedeagus dorsally: 6 – *Leiodes parallela* sp. n., 7 – *L. schneideri* sp. n., 8 – *L. puetzi* sp. n., 9 – *L. semipunctata* sp. n. Scale = 0.1 mm.

Ventrites Without striking characters

Legs Male Tarsi simple slightly dilated Apex of anterior tibiae nearly 3 times as broad as base, about 1.5 times broader than 11th antennal segment Apical thorn of anterior tibiae with two unequal tips Posterior femora with slight blunt angle at hind margin at about basal second fifth of length, distinctly triangular lobe shaped ventrally and with triangular hooked tooth dorsally just before apex Hind tibiae doubly curved Female Tarsi very slightly dilated Apical thorn of anterior tibiae as in male Mesotibiae and posterior tibiae broader than in male, posterior tibiae straight, apex of posterior femora ventrally with long strong curved thorn

Genitalia Aedeagus as in Fig. 7 Parameres multisetose, number of setae not constant

BIONOMY Not known The specimens captured by J. Schneider and D. Král were discovered in falling traps, the specimens captured by J. Farkač partly fall in falling traps and partly they were found under a stone

DERIVATIO NOMINIS It is dedicated to Jan Schneider, one of the captors of the species

DIFFERENTIAL DIAGNOSIS *L. schneideri* sp. n. is similar to *L. curvidens* Angelini et Švec, 1994 in the type of mesosternum, last antennal segment narrower than the 10th, by reduced 9th elytral row and by the emarginate base of pronotum before hind angles It differs mainly by strongly dilated paramerae which are of usual type in the species compared

### *Leiodes schuelkei* sp. n.

(Figs 11, 12)

TYPE MATERIAL Holotype: male, China: Shaanxi, Qian Ling Shan 35° 10' N, 108° 47' E, Mountain W pass at road km 70, 47 km S Xian, 2500–2600 m [above sea level] sifted, 26–27.8.1995, M. Schulke leg. paratypes, 2 females: the same locality and collector Holotype and 1 paratype deposited in SCHC, 1 paratype deposited in SC

DESCRIPTION Body oblong oval Reddish-brown, antennae red, club dark brown Underside yellow-brown

Length of body 2.5–2.8 mm, in holotype 2.8 mm, head 0.4 mm, pronotum 0.6 mm, elytra 1.8 mm, antenna 0.9 mm Maximum width of head 0.6 mm, pronotum 0.8 mm at base, elytra 0.9 mm at basal third

Head Distinctly punctured, punctures separated by 2–3 times their own diameter Four large punctures placed in transverse row before posterior level of eyes Antenna as in Fig. 12 Ratio of length of antennal segments 2 to 11 (the 2nd equal to 1.0) 1.0–1.2–0.7–0.7–0.7–0.9–0.4–1.2–1.2–1.6 Ratio of width of club segments 7 to 11 (7th equal to 1.0) 1.0–0.8–1.3–1.4–1.1 Ratio of width: length of the antennal club segments 1.5–3.0–1.5–1.5–0.9

Pronotum Widest at base, conical shaped, lateral margins straight tapered to middle then curved to anterior angles Posterior sharp angles very closely rounded, in dorsal view Posterior angles blunt closely rounded in lateral view Margins of pronotum nearly straight viewed laterally More finely punctured than head, punctures distributed more sparsely, separated by about 3–5 times their own diameter Interspaces without microsculpture With an irregular row of large punctures before base

Scutellum With traces of chagrination, punctures similar to those on head

Elytra Widest at anterior third In dorsal view, sides straight and slightly divergent from base to basal third Dorsally lateral margins of elytra visible shortly behind shoulders in male, not visible at all in female With regular rows of punctures Short 9th row slightly oblique, nearly parallel to lateral margin, joining lateral channel at proximal two-fifths of elytral length Strial rows composed of punctures of medium size separated by 1.0–2.0 times their own diameter Surface distinctly microreticulate Odd intervals with numerous large punctures as large as those in striae rows In addition all

intervals with punctures similarly developed as those on pronotum. Punctures have tendency to form 2 rows in each interval.

Membranous wings fully developed.

Mesosternum. Carina of type B.

Metasternum. Surface microreticulated. Heart shaped plane bordered by coarse punctures bearing long recumbent setae. Sides of metasternum with shallow irregularly distributed punctures.

Ventrites. Without striking characters.

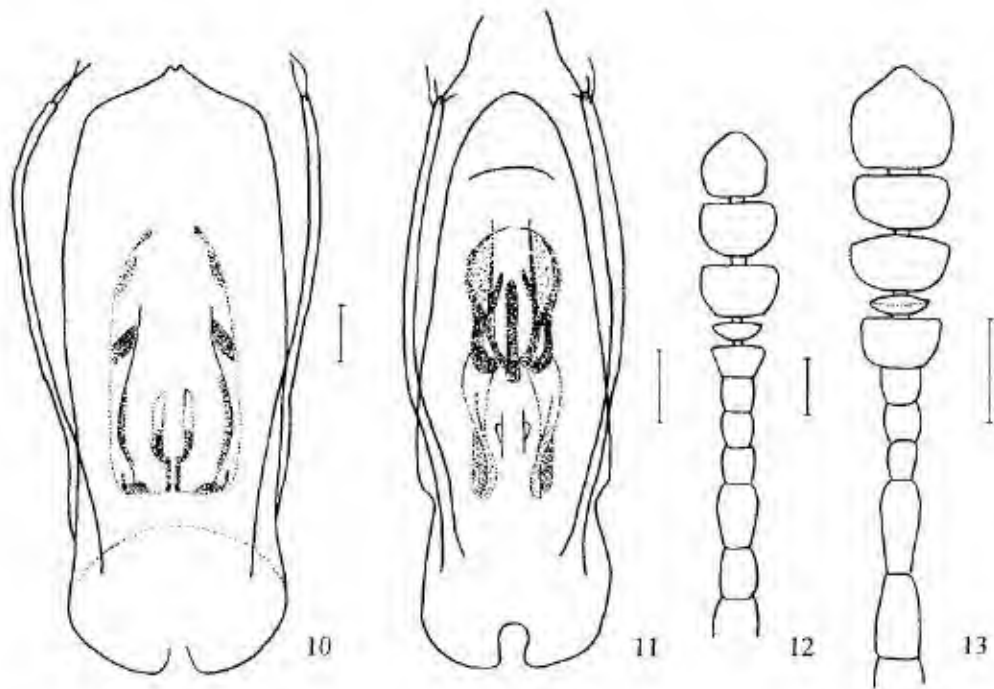
Legs. 2nd to 4th segment of anterior tarsi and mesotarsi slightly but distinctly dilated. Anterior tibiae narrow at apex, 1.4 times narrower than the wide of 11th antennal segment. Posterior femora with tooth at about middle, slightly lobe shaped dilated just before apex in male. Hind tibiae slightly simply curved.

Genitalia. Aedeagus as in Fig. 11.

BIONOMY. Not known.

DERIVATIO NOMINIS. Named after the collector of the new species Michael Schülke.

DIFFERENTIAL DIAGNOSIS. *L. schuelkei* sp. n. resembles *L. ruficollis* (J. Sahlberg, 1898) in the conical shape of pronotum, oblong oval shape of body and weak puncturation of dorsum. It differs mainly by the type of mesosternal carina which is of type A in *L. ruficollis*. The new species is also similar to *L. puetzi* sp. n., *L. becvari* and *L. chinensis* in possessing the same type of mesosternal carina, by



Figs 10-13. 10-11: aedeagus dorsally: 10 - *Leiodes sichuanica* sp. n., 11 - *L. schuelkei* sp. n. 12-13: antenna: 12 - *L. schuelkei* sp. n., 13 - *L. semipunctata* sp. n. Scale = 0.1 mm.

the type of elytral puncturation and by the last antennal segment narrower than the previous one. *L. schuelkei* sp. n. differs by the shape of tegmen that is broadly rounded at apex, while the tegmen ends by small bump at the apex or by very shortly rounded tip in the species compared here.

*Leiodes semipunctata* sp. n.

(Figs 9, 13)

TYPE MATERIAL. Holotype, male, China, Shaanxi, Qim Ling Shan, 110° 06' E, 34° 27' N, Hua Shan Mts., N. Valley 118 km E Xian 1200–1400 m [above sea level], 18–20 viii 1995, sifted, A. Putz lgt. Deposited in SC.

DESCRIPTION. Body oval. Light chestnut coloured, underside, antennae and palpi red-yellow.

Length of body 2.3 mm, head 0.3 mm, pronotum 0.6 mm, elytra 1.4 mm, antenna 0.6 mm. Maximum width of head 0.6 mm, pronotum 1.2 mm at base, elytra 1.4 mm at first third.

Head. Distinctly coarsely punctured, punctures separated by 2–3 times their own diameter. Four large punctures placed in transversal row before posterior level of eyes. Antenna as in Fig. 13. Ratio of length of antennal segments 2 to 11 (the 2nd equal to 1.0): 1.0–1.4–0.8–0.6–0.6–0.9–0.4–0.9–1.0–1.5. Ratio of width of club segments 7 to 11 (7th equal to 1.0): 1.0–0.8–1.3–1.4–1.4. Ratio of width: length of the antennal club segments: 1.4–2.7–1.9–1.8–1.2.

Pronotum. Widest at base, lateral margins flatly rounded to anterior angles. Posterior sharp angles broadly rounded, in dorsal view. Posterior angles blunt, with well-marked tip in lateral view. Margins of pronotum nearly straight shortly before hind angles, then roundly tapered to anterior angles in lateral view. A little finer and more sparsely punctured than on head, punctures irregularly distributed separated by about 3–4 times their own diameter. Some small places on disc without puncturation present. Interspaces with traces of microreticulation. A transverse irregular row of large punctures before base.

Scutellum. Smooth except for several distinct punctures.

Elytra. Widest at anterior third. Dorsally lateral margins visible at shoulders only. With regular rows of punctures. Short 9th row distinctly oblique joining lateral channel at proximal third. Rows composed of punctures of medium size separated by 1.0–2.5 times their diameter. Odd intervals with larger punctures as large as those in rows. All intervals with very scattered small punctures occasionally missing altogether. Interstices smooth shiny.

Membranous wings fully developed.

Mesosternum. Carina of type A.

Metasternum and ventrites. Without striking characters.

Legs. Segments 2–4 of anterior tarsi and mesotarsi slightly but distinctly dilated. Anterior tibiae narrow at its apex, 1.5 times as wide as at base. Posterior femora slightly lobe shaped dilated just before apex in male. Hind tibiae slightly simply curved.

Genitalia. Aedeagus as in Fig. 9.

BIONOMY. Not known.

DERIVATIO NOMINIS. It is derived from the feebly punctured elytral intervals.

DIFFERENTIAL DIAGNOSIS. *L. semipunctata* sp. n. is compared to *L. brunnea* (Sturm, 1807) and *L. sichuanica* sp. n. in possessing the same type of mesosternal keel, small shining body, widely rounded hind angles of pronotum and by feebly punctured elytral intervals. *L. semipunctata* sp. n. differs from both species in last antennal segment which is as wide as the previous one, while the same one is narrower in *L. brunnea* and in *L. sichuanica* sp. n. It differs also by different shape of aedeagus and endophallus and by the length of paramerae reaching over the tegmen, while the same is shorter in the species compared, here.



*Leiodes sichuanica* sp. n.

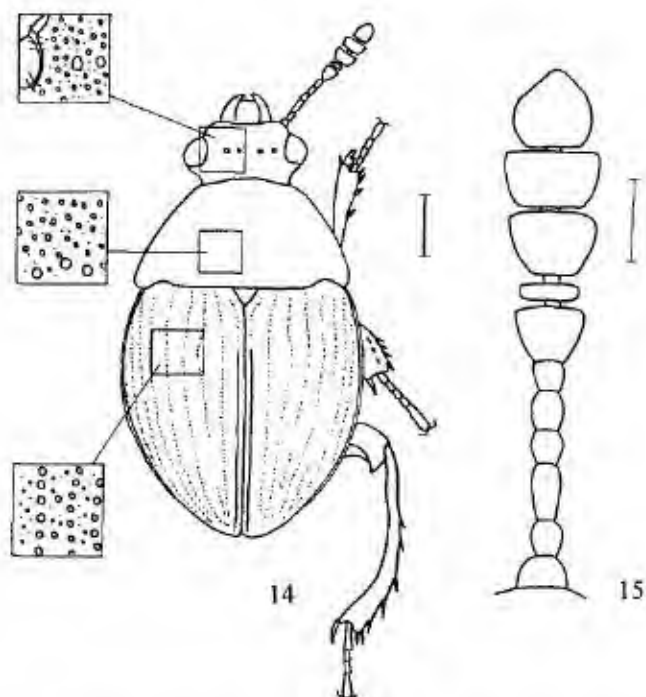
(Fig. 10)

TYPE MATERIAL. Holotype, male, China, Sichuan, Emeishan, Leidongping, 2500 m, 18.vii.1996, 29° 32' N, 103° 21' E, collected by A. Smetana, J. Farkaš, P. Kabátek, deposited in SC.

DESCRIPTION. Body oval. Yellow-brown, head a little darker, mouth parts, tarsi and antennal segments 1–6 yellow, antennal club infusate, tibiae lightly yellow brown, underside and femora yellow-brown.

Length of body 2.9 mm, head 0.3 mm, pronotum 0.7 mm, elytra 1.9 mm, antenna 0.9 mm. Maximum width of head 0.8 mm, pronotum 1.4 mm at base, elytra 1.5 mm at base, 1.6 mm in basal third.

Head. Slightly regularly microreticulate, cells of microsculpture become transversely elongated at temples. Distinctly finely punctured, punctures separated by 2–4 times their own diameter. Four large punctures placed in transversal row before posterior level of eyes. Closely to internal margin of each eye 1 large and 2 smaller setae bearing punctures visible laterally. Ratio of length of antennal segments 2 to 11 (the 2nd equal to 1.0): 1.0 – 1.3 – 0.7 – 0.6 – 0.5 – 1.0 – 0.4 – 1.1 – 1.2 – 1.6. Ratio of width of club segments 7 to 11 (7th equal to 1.0): 1.0 – 0.7 – 1.3 – 1.4 – 1.1. Ratio of width : length of the antennal club segments: 1.2 – 2.0 – 1.4 – 1.4 – 0.8.



Figs 14, 15, *Leiodes schneideri* sp.n.: 14 – shape of body, 15 – antenna, Scale in Fig. 14 = 0.2 mm, in Fig. 15 = 0.1 mm.

**Pronotum** Pronotum widest at base, lateral margins conically narrowed toward anterior angles with slightly rounded sides. Posterior angles sharp broadly rounded, viewed dorsally. Posterior angles very blunt very closely rounded in lateral view. Lateral margins of pronotum nearly straight to middle, then curved to anterior angles, seen laterally. Slightly regularly microreticulate. A little finely and more sparsely punctured than on head, punctures irregularly distributed separated by about 3–6 times their own diameter. A transverse irregular row of large punctures before base.

**Scutellum** Smooth except of several distinct punctures.

**Elytra** Widest in basal third of their length. Dorsally lateral margins visible for first half of their length. Without microreticulation. With regular rows of punctures. Short 9th row slightly oblique, joining lateral channel just before proximal third. Rows composed of small punctures separated by 2–4 times their diameters. Odd intervals with some punctures larger than those in rows. Intervals 3 and 4 on disc with some small, very short setae bearing granules present in second quarter from base on elytra. These punctures separated by about 2–3 times their diameter. Some of those punctures very rarely present also in 2nd and 5th elytral intervals. Punctures of usual shape present in basal quarter and distal half of elytra. These normal fine punctures separated by about 4–5 times of their diameter gradually disappearing toward base, apex and lateral sides of elytra.

Membranous wings fully developed.

**Mesosternum** Carina of type A.

**Metasternum and ventrites** Without striking characters.

**Legs** Segments 1–4 of anterior tarsi and mesotarsi slightly dilated. Anterior tibiae narrow, at apex twice as wide as at base. Eleventh antennal segment 1.25 times wider than anterior tibia at its end. Posterior femora simple, without any lobes or other striking characters, hind tibiae slightly simply curved in male.

**Genitalia** Aedeagus as in Fig. 10.

**BIONOMY** Not known.

**DERIVATIO NOMINIS** It is derived from the name of the Sichuan province where the holotype was found.

**DIFFERENTIAL DIAGNOSIS** *L. sichuanica* sp. n. is compared with *L. brunnea* and *L. semipunctata* sp. n. in possessing the same type of mesosternum, small shining body, widely rounded hind angles of pronotum and by feebly punctured elytral intervals. *L. sichuanica* sp. n. differs from both species compared by the presence of granules on elytra, from *L. brunnea* by longer antennae, from *L. semipunctata* sp. n. by last antennal segment narrower than the previous one. The same segment is as wide as the previous one in *L. semipunctata* sp. n. *L. sichuanica* sp. n. differs also by different shape of aedeagus that ends by small central notch at its tip.

## DISCUSSION

There are 73 species of the genus *Leiodes* Latreille, 1796 known from Asia (Daffner 1983, Daffner, 1986, Nakane 1963, Nakane 1989, Perkovsky 1990, Angelini & Švec 1994, Švec 1991, Švec 1996, Švec 1998, Švec 1999). Altogether 21 species occur in China and Taiwan. Five of them occur beside China also in other parts of the Palaearctic. Five species are shared in both the Holarctic regions of the Old World and North America (Baranowski 1993).

The following diagram indicates geographical distribution of the species. Stars represent the distribution. Horizontal lines separate groups of similar species. The groups erected newly in this paper are based on the similarity of the species mainly in possessing the same type of mesosternal carina, shape of tegmen, parameres and endophalus and also in some external characters as the shape of pronotum and the sculpturation of dorsum are. Data about distribution was taken from the literature cited above. The areas are bordered like this: N – Africa – Palaearctic part of Africa, Europe

— including Caucasus; Asia part (entire Asia except of Siberia, China and Japan) — Turkey, Saudi Arabia peninsula, Iraq, Iran, Afghanistan, Syria, Azerbaijan, Kazakhstan, Uzbekistan, Turkmenistan, Tadzhikistan, Kyrgyzstan, Mongolia, Western and Eastern Sayan, Nepal, Northern India; China — continental China, Taiwan; Siberia — Asian part of Russia except of Sayan.

#### Distribution of the Asian species of the genus *Leiodes* Latreille, 1879

species	N-Africa	Europe	Asian part of Russia	China	Siberia	Japan	N-America
<i>L. furva</i> (Erichson, 1845)		*	*				
<i>L. rufipes</i> (Giebler, 1833)			*	*	*		*
<i>L. fracta</i> (Seidlitz, 1874)		*			*	*	
<i>L. rhaetica</i> (Erichson, 1845)		*	*		*		*
<i>L. picea</i> (Panzer, 1797)		*	*		*		
<i>L. daffneri</i> Perkovsky, 1990			*			*	
<i>L. major</i> (Portevin, 1926)			*				
<i>L. spurreschnelderi</i> (Strand, 1943)		*	*		*		
<i>L. polita</i> (Marsham, 1802)	*	*	*				
<i>L. stucki</i> Švec, 1996			*				
<i>L. dilutipes</i> (J. Sahlberg, 1903)			*	*	*		
<i>L. snizeki</i> Angelini et Švec, 1994				*			
<i>L. flavescens</i> (Schmidt, 1841)		*			*		
<i>L. rufipennis</i> (Paykull, 1798)		*	*		*		
<i>L. dubia</i> Kugelann, 1794		*			*		
<i>L. bicolor</i> (Schmidt, 1841)	*	*	*	*	*		
<i>L. rhesa</i> (Schmidt, 1841)		*	*		*		
<i>L. franki</i> Daffner, 1986			*				
<i>L. mathiasii</i> Švec, 1999			*				
<i>L. parallela</i> sp. n.				*			
<i>L. lucens</i> (Fairmaire, 1855)		*	*	*	*		
<i>L. asavai</i> (Nakano, 1963)						*	
<i>L. atricolor</i> (Champion, 1923)			*				
<i>L. mirkae</i> sp. n.				*			
<i>L. steslata</i> (Kraatz, 1852)		*			*		
<i>L. schuelkei</i> sp. n.				*			
<i>L. guetzi</i> sp. n.				*			
<i>L. chinensis</i> Angelini et Švec, 1994				*			
<i>L. hecvari</i> Angelini et Švec, 1994				*			
<i>L. alexandrae</i> Angelini et Švec, 1994				*			
<i>L. semipunctata</i> sp. n.				*			
<i>L. sichuanica</i> sp. n.				*			
<i>L. curticornis</i> (Hlissnikovský, 1967)			*		*		
<i>L. curtisale</i> Daffner, 1983			*		*		
<i>L. irepkei</i> (Schmidt, 1841)		*	*		*		*
<i>L. rubiginosa</i> (Schmidt, 1841)		*			*		
<i>L. rugosa</i> Stephens, 1829		*			*		
<i>L. turcica</i> Švec, 1998			*				
<i>L. pilifera</i> (Reitter, 1884)		*	*				
<i>L. ciliata</i> (Schmidt, 1841)		*	*				
<i>L. punctulata</i> (Gyllenhal, 1810)		*			*		*
<i>L. carinipes</i> (Rye, 1873)						*	
<i>L. multipunctata</i> (Rye, 1873)						*	
<i>L. tsuensis</i> Nakano, 1989						*	
<i>L. punctuollis</i> (Thomson, 1862)		*					*
<i>L. ferruginea</i> (Fabricius, 1787)		*		*	*		
<i>L. portevinii</i> Hatch, 1929						*	

species	N-Africa	Europe	Asian part of Russia	China	Siberia	Japan	N-America
<i>L. jakobi</i> (Hlasičkovský, 1964)		*	*				
<i>L. mikodymi</i> Švec, 1991				*			
<i>L. variabilis</i> Daffner, 1986			*				
<i>L. loebli</i> Daffner, 1986			*				
<i>L. nepalensis</i> Daffner, 1983			*				
<i>L. smetanai</i> Daffner, 1986			*				
<i>L. curvadens</i> Angelini et Švec, 1994				*			
<i>L. schneideri</i> sp. n.				*			
<i>L. craticollis</i> (Portevin, 1943)			*				
<i>L. klapperichi</i> Daffner, 1983				*			
<i>L. okawai</i> Nakane, 1963						*	
<i>L. ulpicola</i> Nakane, 1963						*	
<i>L. babai</i> Nakane, 1989						*	
<i>L. jaroslavi</i> Angelini et Švec, 1994				*			
<i>L. subtilis</i> (Reitter, 1885)		*	*		*		
<i>L. xunyangensis</i> Angelini et Švec, 1994			*	*			
<i>L. badia</i> (Sturm, 1807)	*	*			*		
<i>L. lehmani</i> Švec, 1999			*				
<i>L. besucheti</i> Daffner, 1986			*				
<i>L. bengalica</i> Daffner, 1986			*				
<i>L. contracta</i> (Portevin, 1903)			*				
<i>L. ampla</i> (Reitter, 1887)			*				
<i>L. imeritima</i> (Reitter, 1890)			*				
<i>L. rectangula</i> (Reitter, 1884)			*				
<i>L. colenoides</i> (Reitter, 1913)					*		
<i>L. convera</i> (Motschulsky, 1845)					*		

The general geographical distribution indicated in the diagram is basic and incomplete because of several reasons, one being the fact that the areas mentioned in the table are roughly defined because it could not be taken into account phytogeographical areas, height above sea level, geological and geographical conditions, climate etc. It was not reckoned with these aspects because of sporadic and uncompleted data concerning to the occurrence of individual species. The *Leiodes* material was collected in the Old World and in China unsystematically, occasionally at random until now. So the important collecting data are mostly lacking. Further it can be said with certainty that there will be discovered many new species in China and adjacent countries in the future.

Any responsible and serious conclusion about the geographical distribution requires more detailed knowledge about the species of the genus *Leiodes*. This point seems to be impossible to solve at the present. Baranowski (1993) erecting species groups in the genus noticed: "The separation into 26 species-groups as proposed in this revision is based on the New World fauna only and must be considered as a tentative and intuitive classification." I also believe that any attempting of phylogenetic classification of the *Leiodes* species could be rather premature with the present state of knowledge. Major taxonomic and faunistic work in the genus *Leiodes* stands before us.

#### Acknowledgement

My sincere thanks belong to Jan Růžicka (Czech Agricultural University, Praha) and Jonathan Cooter (Hereford, UK) for the checking of the manuscript and of course all the entomologists mentioned in this paper who provided me with Chinese material.

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## BOOK REVIEW

CLEMENTS A. N. *The Biology of Mosquitoes. Volume 2 Sensory Reception and Behaviour*. Wallingford, Oxon: CABI Publishing, a division of CAB International, 1999. XV+740 pp. Format 185×245 mm. Hard bound, price Lstg 95.00 (USD 175.00). ISBN 0-85199-313-3.

The author is a professor affiliated with the London School of Hygiene and Tropical Medicine. This is the second of the three projected volumes of *The Biology of Mosquitoes*. Volume 1 published by Chapman and Hall in 1992 focused on development, nutrition and reproduction, growth and metamorphosis of larval and adult forms of mosquitoes, egg production by the adults females and physiological adaptations of larvae to their aquatic environment. This second title provides information on the physiology of mosquito sensory organs and behavioural patterns. In the introduction looked at are biological cycles, endogenous rhythms, diel and lunar periodicities in mosquito behaviour. The volume is composed of 17 chapters numbered in consequence of the preceding volume 1 from 24 through 40.

Chapter 1 (24) describes integumental sensilla of culicid larvae comprising articulated setae of the body surface, antennal and maxillary sensilla. Following chapter 2 (25) is dedicated to adult integumental sensilla. Chapter 3 (26) concentrates on antennae and hearing. Chapters 4 and 5 (27 and 28) deal with larval and adult eyes and vision. The chapter 6 (29) on behaviour of larvae and pupae characterizes aquatic environment in relation to locomotion, taxis and kinesis, escape from predators, feeding behaviour, grooming and various other activities. Following chapters highlight adult circadian rhythms and the regulation of adult behaviour, including regulation of male and female sexual activities. Chapters 9 and 10 (32 and 33) lay emphasis on the modification of adult behaviour by geophysical and climatic factors and on the flight. Next two chapters provide coverage of male and female genitalia and associated organs and the mating.

Chapter 13 (36) deals with feeding on plant sugars. Chapters 14 and 15 (37 and 38) are concerned with sources and characteristics of host cues and with host finding, namely with reactions of mosquitoes to chemical, physical and visual stimuli and with behavioural patterns exhibited by mosquitoes responding to host over a distance. Chapter 16 (39) analyses mosquito-host interactions, with particular emphasis on the host specificity and defensive responses of the host, blood-meal identification by serological methods, factors determining host feeding patterns, and transmission of parasites. The concluding chapter is devoted to detailed analysis of behavioural events leading to egg laying.

The volume includes a comprehensive list of references and is augmented by a wealth of figures numbered by individual chapters, composed of schematic line drawings, photographs and graphs. In addition, there are numerous tables summarizing data given in the textual part. Eleven chapters contain thematic glossaries of terms relating to blood feeding, host finding, mating, oviposition, rhythmic and cyclic behaviour and other terms.

Mosquitoes are important transmitters of widespread major diseases as are malaria and arboviruses. They are also one of the most studied and well known group of insects, both in the laboratory and in the field. This volume offers an in-depth review of biology of sensory organs and environmental relations influencing the vertebrate host attack by mosquitoes. Following volume 3 in preparation, approximate publication date 2004, is intended to inform on dormancy, survival, speciation and evolution.

*Jindřich Jirá*



## Variability of behavior in the larvae of *Aphodius (Colobopterus) erraticus* (Coleoptera: Scarabaeidae)

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**Abstract.** Larvae of the 1<sup>st</sup> and 2<sup>nd</sup> instars of *Aphodius (Colobopterus) erraticus* (Linnaeus, 1758) were found in chambers inside brood masses under laboratory conditions. The chambers were closed by a wall formed probably from larval faeces. This is hypothetically explained as an adaptation to markedly increased soil moisture. Consequently, one of the features of the evolution of the oviposition habits in *A. (C.) erraticus* and *A. (C.) quadratus* Reiche, 1842 was corrected as follows: only the larvae of the 3<sup>rd</sup> instar feed on the brood mass from outside as a rule.

**Nesting, larvae, biology, ethology, Coleoptera, Scarabaeidae, Aphodiinae, *Aphodius erraticus***

### INTRODUCTION

Most advanced nesting-like reproductive pattern within the genus *Aphodius* Illiger, 1798 was found in *Aphodius erraticus* (Linnaeus, 1758) and *A. quadratus* Reiche, 1842, two dung beetles of the subgenus *Colobopterus* Mulsant, 1842 (Rojewski 1983, Hosogi 1985, Yasuda 1987, Yoshida & Katakura 1992, Zunino et al. 1994). These species form elongate brood masses serving as a food source for all three larval instars, and locate egg chambers in soil outside the brood mass. This observation was adequately used in the formation of a model of the evolution of the oviposition habits in *Aphodius* (Yoshida & Katakura 1992).

In a discussion of the results of Yoshida & Katakura (1992) I mentioned as one of the features of the evolution of the oviposition habits, that the larvae of all three instars of these two species feed on the brood mass from outside (Vitner 1998). Further research showed, that this characteristic was erroneous. The aim of the present paper is to correct this error.

### MATERIAL AND METHODS

**Origin of parental individuals.** Italy, Province of Tuscany, Alberese near Grosseto, 27 iv 1998, J. Hubert leg.

Three males and two females were kept from 29 iv 1998 in a quadratic plastic box measuring 16.0 × 9.5 × 9.5 cm. The front part of the box was cut out, excepting a 2 cm broad belt, and after first control again pasted on back with Hercules dispersion gum (Druchema, Praha). The box was filled with soil mixed with ca. 20% of sand, the layer of which reached ca. 10 cm, and covered with fine netting, held by a rubber band. Most of the soil surface in the box was covered by a ca. 3 cm thick layer of fresh bison dung from ZOO Praha, leaving a 1–2 cm broad side belt uncovered. The box was located in an unheated room (temperature ca. 17–20 °C) and was exposed to the day light. Dung and soil were scratched out from a side – layer by layer by a pincette during the first control on 4 v 1998. The soil was then returned back together with the broken dung. The brood was finished after the second control on 10 v 1998.

Size of brood masses was measured using caliper to the nearest 1 mm. Maximum width is given for each brood mass. Only one dimension is given for cylindric brood masses (Nos 1–6, 8 in Tab. 1, see also Figs 1–2), while width of the lower end and width of the base are given for conic brood masses (Nos 7, 9 in Tab. 1, see also Figs 3–4).

Parental adults and larvae were treated with Bouin's fluid and preserved in 70% ethanol after the end of the experiment. They are deposited in the author's collection.

## RESULTS

Nine brood masses were found during the first control of the box (see Tab. 1 and Figs 1–4). One brood mass was formed as a food source for two larvae (Fig. 3), while seven brood masses for a single larva each, the latter being probably true also for the last brood mass (Nr. 8 in Tab. 1). Two brood masses were located close to each other, forming a cluster (Nrs 4, 5 in Tab. 1, Fig. 2). Bases of all brood masses were close to the dung pad. Soil was rather moist during this control.

Larvae were found in all brood masses, with the exception of Nr. 2 and Nr. 8. External opening of the larval chamber was found only on the brood mass Nr. 1, but it cannot be excluded that the closure of the larval chamber was damaged during the manipulation with the brood mass. External openings were absent from brood masses Nrs 3–7 and 9. In these brood masses, chambers were closed with a smooth, ca. 1 mm thick, fine-grained wall, which was probably formed from larval faeces. The texture of this wall was distinctly finer than the texture of the surrounding brood mass. Opening of the larval chamber was visible from outside in the brood mass Nr. 2.

Only a single feeding  $L_1$  (not yet white, preparing for pupation) was found during the second control.

## DISCUSSION

The data presented above indicate – contrary to the data formerly published by Vitner (1998) – that  $L_1$  and at least to some degree also  $L_2$  of *Aphodius erraticus* are able to feed on the brood mass from both inside and outside (see also Rojewski 1983: 273 [fig. 8], 275, although his statement is not quite clear). The relevant part of the characteristics of the tendency of the evolution of the oviposition

Table 1. Data on brood masses (dimensions in mm).

Nr.	Width	Width of the base	Width of the lower end	Length	Record
1	7			20	$L_1^{(3)}$
2	8			22	– <sup>(3)</sup>
3	8			33	$L_1^{(3)}$
4–5	7–8			16	$L_1^{(3)}$
	7–8			22	$L_1^{(3)}$
6	9			15	$L_1^{(3)}$
7		12	9	42	$L_1^{(3)}$ , $L_2^{(4)}$
8	10			23	– <sup>(3)</sup>
9		12	7	26	$L_1^{(3)}$

<sup>(3)</sup> Neither larva nor egg found: no traces of feeding on the brood mass.

<sup>(4)</sup> Opening of larval chamber at the lower end of the brood mass, see Fig. 1.

<sup>(5)</sup> Opening of larval chamber at the lower end of the brood mass, larva found neither in the brood mass, nor in the soil.

<sup>(6)</sup> Opening of larval chamber approximately 1/3 of the length of the brood mass from its lower end. Brood mass damaged during the control and position of the opening was not measured. The larva was shortly after ocdysis, still without grayish food in its digestive tract.

<sup>(7)</sup> Upper end of the opening of larval chamber ca. 4 mm below the base of the brood mass, see Fig. 3.

<sup>(8)</sup> Opening of larval chamber ca. 15 mm above the lower end of the brood mass, see Fig. 3. The abdomen of larva was so far slender, with well visible grayish food in its digestive tract.

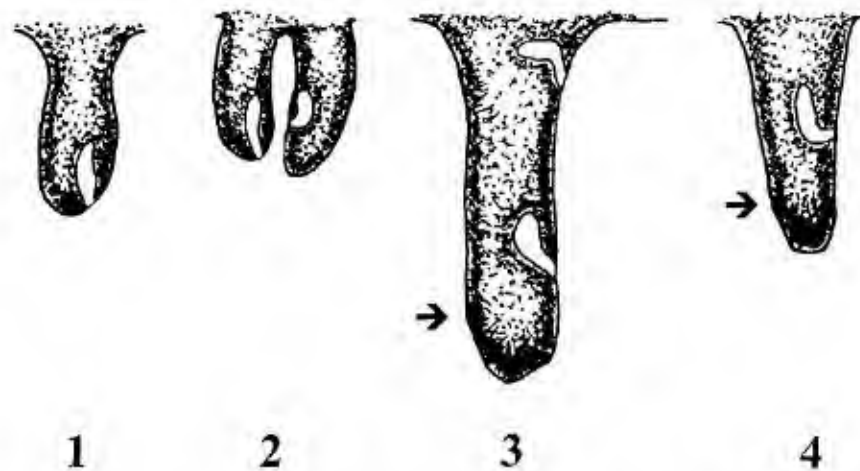
<sup>(9)</sup> Opening of larval chamber ca. 11 mm above the lower end of the brood mass, see Fig. 4.

habits represented by *A. erraticus* and *A. quadratus* (Vitner 1998: 250) must be modified accordingly. I think that the possibility that also  $L_3$  could feed on brood masses from inside must be ruled out, just because of the size of these larvae (cf. Emden 1941, Jerath 1960, Kim & Lumaret 1987, Rojewski 1983, Frolov 1994) in comparison with the diameter of brood masses (cf. Rojewski 1983, Hosogi 1985, and this paper). It is probable for the same reason, that older  $L_2$  usually feed on the brood mass from outside as well.

I am not able to explain sufficiently, why larvae feed on brood masses sometimes from outside and sometimes from inside. With some limitations (cf. brood mass Nr. 2 in Tab. 1) I prefer the following explanation: when soil is drier than a brood mass, a hard layer forms around the brood mass and prevents further dessication. A cavity forms between this layer and the brood mass, and larvae of the first two instars feed on the brood mass from outside. On the other hand, when soil is moist, the gradient is reversed. Hard layer is glued to the brood mass and owing to its more dense texture can function as a barrier preventing moisture to penetrate from the soil in the brood mass. A cavity around the brood mass is not formed. In such a case the larvae enter brood mass, feed out a chamber and close it by their own faeces using modified anal lobes. Inside the brood mass they are safer before adverse effects of "too" high moisture (moulds etc.) than they would be outside of the brood mass.

The ability of the larvae of *A. erraticus* to form larval chambers can to some degree help to hypothesize about the functional explanation of the morphology of their mandibles. The slender incisive part of mandibles (cf. Kim & Lumaret 1987 for *A. quadratus*) is suitable for finer movements than are those needed for a simple separation of food. However, it remains unexplained why slender shaped mandibles are present in all three larval instars (Vitner 1996).

"Nesting" pattern of *A. erraticus* and *A. quadratus* can be regarded as well defined (Vitner 1998). The results presented above indicate, that the larvae of first two instars can effectively react on environmental conditions. This, and the ability of the larvae, especially those of  $L_3$ , to feed directly inside the dung pad (Rojewski 1983, Yoshida & Katakura 1992, Zunino et al. 1994, Vitner 1998), is an evidence for the plasticity of larval behavior in these species.



Figs 1–4. Schematic drawing of brood masses of *Aphodius erraticus* (Linnaeus) with larval chambers. Arrows indicate place where the width of the lower end of brood masses were measured. For the data see Tab. 1.

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